THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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DUAL COMMISSIONS.

WHEN the Council of the Institution of Electrical Engineers issued its code of professional etiquette for consulting electrical engineers, just a couple of years ago, there were certain critics who were bold enough to object to some of the rules laid down therein. But we do not think that anyone found the least fault with No. 5, which read:—

No consulting engineer should receive trade or other discount, or surreptitious commissions or allowances in connection with any work which he superintends.

This must have commended itself to all, save those upon whose conduct a reflection was cast, as being a reasonable and just requirement, which must be complied with if there is to be anything like fair dealing between a consulting engineer and his clients. It were a thousand pities that, in a profession of this kind, any such stricture should ever be called for; but we do not dispute for a moment that the Council was amply justified in thus expressing itself. Commission transactions coming under this description there have been, and we have strong reasons for believing there are to-day; such transactions are not such complete secrets as the parties to them may suppose, for little birds get hold of and carry whisperings of awkward gossip in the least expected directions. Specific charges against particular men do not often find their way into print, but those who have to do with the technical Press are continually hearing such and such a story about this, that and the other consulting engineer whose hands are said to be soiled in the manner alluded to. Such allegations are among the most difficult of verification, and are not pleasant hearing, and we prefer, where we can, to dismiss them as gossip, rumour, or non-proven statements. We cannot believe that dual commissions are at all frequent in the ranks of consulting electrical engineers; and we are inclined to believe that these reports which pass from lip to lip in the course of professional conversation are altogether exaggerated in themselves, and that they can only be made with any likelihood of accuracy in very few cases—the black sheep, may we call them, from which no fold is free. We would not deny that such a thing does obtain; our desire is rather to minimise the extent of so reprehensible a practice. To stamp it out altogether is the most desirable end, but it is one most difficult of attainment.

There are two parties to commission arrangements—sometimes, perhaps, more. We have spoken of one thus far—the consulting engineer, but we fear that there is also need for a very straight talk to those who pay, or offer to pay, these commissions with the idea of influencing engineers in favour of certain makes of electrical articles when specifying. True it is that competition is keen, but a manufacturing business which can only keep going by greasing the palm of consulting engineers ought to shut its doors altogether.

We do not think that manufacturers will take umbrage at our reference to this matter, for the great majority are

beyond reproach, and will lend their support to any reasonable effort tending in the direction of greater commercial and professional fairness. We are tempted to suggest that it is only from quarters where the cap fits uncommonly well that objection will be forthcoming.

Perhaps some of our readers may wonder why we have returned to this subject at this particular moment. Let us explain. During the last few days there has been shown to us a letter received by a firm of consulting electrical engineers from a London branch of a certain electrical manufacturing company. This letter draws attention to some apparatus, and offers the services of the company's representative to call at any time in order to grant "special confidential terms" for any business done in their machines, the arrangement being naïvely suggested only in the event of the consulting engineers in question not being "tied up to any particular make of machine." Those who have allowed us to peruse this communication have charitably supposed that it has been addressed to consulting engineers under the misapprehension that they are something else. But this is too charitable a view to take of a case so glaring in character. If pushfulness in business is to be accompanied by this sort of thing, then we are sorry for the reputation of British electrical industry—it will be no better than that prevailing in some other countries.

Our consulting engineers and manufacturers alike should take a firm stand in regard to the matter. The Institution has said what it thinks of the guilty consulting engineer, and he knows what to expect if his conduct comes to the light of day. But what can be done with the defaulting manufacturer? Has the Manufacturers' Association a black list of its members who transgress in this particular? And has it another black list also of consulting engineers who have a hand open behind their back?

MUNICIPAL TRADING: SOME FIGURES AND AN EXAMPLE.

As a result of recent object lessons, the ratepayers of Brighton are just now up in arms on the subject of municipal extravagance and mismanagement. To judge from some of the statements and figures published in the Brighton newspapers, the ratepayers of London-by-the-Sea have good cause for the indignation they are so freely and vigorously expressing at crowded mass meetings and in letters to the Press. A few of these statements and figures will suffice to show how far the enjoyable occupation of spending other people's money has been carried by the Brighton Town Council. During the past five years the amount added to the borough debt of Brighton, for what town councillors, too often in a purely Gilbertian spirit, call "remunerative" works, was £913,000, and for what are frankly termed unremunerative works, £365,000, making a total borrowing in five years of, in round figures, £1,280,000. Of this sum over £344,000 was added during the twelve months ended March last. The total debt is now over £2,377,000, with a further liability of £100,000 for electricity works contracted but unprovided for.

These figures, and others, were given by Mr. J. F. Blacker, at a mass meeting held at the Dome last week to promote the cause of retrenchment and reform in Brighton municipal affairs. That the "remunerative" works would hardly make private proprietors very happy, may be gathered from the fact that the rates have gone up from 5s. 1¾d. in 1894, to 7s. 2d. in 1904. This increase has occurred in spite of the fact that a 1d. rate now produces £3,200, as against £2,745 ten years ago, making the total increase in the rates over 55 per cent. Other speakers said that assessment values had been largely increased, and one gentleman in the audience handed Mr. Blacker papers which showed that on the house on which the rate in 1900 was £4 2s. 10½d. no less than £10 8s. was demanded in 1904, an increase of 250 per cent.! Small wonder that the Brighton ratepayer is indignant. The total rate, according to Mr. Blacker's figures, has risen from £166,000 in 1894 to over £281,000 at the present time, an increase of £115,000 a year. This is, to say the least, a curious accompaniment to an investment of £913,000 in "remunerative" works.

Where had the money gone? asked Mr. Blacker, and proceeded to answer his own question by giving some details of the loose way in which capital is squandered in municipal trading. Tramways showed a loss; the Aquarium showed a heavy loss. Coming to more recent events, Mr. Blacker referred to the competitive telephone system established by the Corporation. They had estimated that £43,280 would produce 2,080 completed lines. Up to August they had spent £43,444, and had 1,340 working lines, or £32 a line actual cost, as against £20 10s. estimated cost. A capital of £43,280 was estimated to produce a revenue of £11,469, but £43,444 had been spent, and the revenue was only £6,000. The Telephone Committee insisted on charging wages of canvassers and others to capital, in order to make a better showing for the revenue account, which Mr. Blacker considered a most unbusinesslike proceeding.

In another Brighton paper we find a report on the municipal telephone system, which illustrates one of the worst features of municipal trading in technical industries. Town Councillors are necessarily novices in the management of a technical business, and they often show a ludicrous simplicity in accepting and publishing reports and statements which a business man in the least familiar with the affair would subject to close scrutiny and a heavy discount. This particular report estimates that, on six months' working, a surplus of about £98 will be arrived at. No charge for depreciation is made, and, as already noted, canvassers' wages and other expenses are charged to capital. Great joy is manifested over the balance of £98. The fact is ignored that the previous account showed a deficit of over £1,200, and so is the further fact that from the present calculations are omitted charges that would turn the balance of £98 into a loss of nearly £1,000, while any idea that as the plant—now new and of very small dimensions—ages and grows, expenses of operation and maintenance may be expected to grow is wholly absent. The number of instruments connected is only 1,448, which seems to be considered a startling performance, but they are evidently very little used, as the traffic amounts to barely three calls per instrument daily. The switchboard has a capacity of 2,000 subscribers' lines, and the cables a capacity of 2,500, from which facts the manager ingenuously deduces the encouraging opinion that the next 500 subscribers will be nearly all profit.

When one sees a town council, or a committee of town councillors, accept and publish such amateur nonsense as this, relating to a business involving a first investment of over £43,000, to be followed by the frequent investment of other substantial sums, one can well understand the rapid growth in both the capital and annual expenditures of

municipalities which has accompanied the extension of municipal trading. The root of the whole evil, as aptly expressed by Mr. Blacker, is the fatal facility with which money can be borrowed. Evidently, for example, it is no difficult matter for a group of men on a town council to induce the Council to borrow a large sum, say £40,000, to start a competing telephone system. Not a solitary councillor seems to have the foresight to see that even this substantial sum, under competitive conditions, is only a starting point, and that under stress of competition more capital must be added at frequent intervals. No detailed study is undertaken to ascertain what will be the probable course of the venture during a period of years. No one concerned looks beyond the end of his own nose, nor apparently sees anything in the proposal beyond the chance to spend £40,000 in a year. The estimate says, capital £42,000, revenue for one year £11,500, expenses for one year £11,150, surplus £350. What could be simpler or more alluring? Let the after years take care of themselves.

The money is borrowed, and, amid rejoicings at the Town Hall, the wonderful feat is accomplished of building a telephone system of 2,000 lines in a town of 150,000 or 250,000 inhabitants. Then, the money having been spent, and the venture started, accounts are got out to show that on a capital of £40,000, a surplus of a hundred or two from a year's working may be arrived at—on paper. No matter that to calculate such a result requires legitimate charges against revenue to be transferred to capital account or to be dropped altogether, or that nearly every part of the scheme has resulted differently from the original plans. Municipal trading must show a success—on paper—if a success can possibly be constructed out of the materials available, and municipal self-love cannot admit a mistake of any sort if it can possibly be concealed or disguised. No personal responsibility being involved, human nature asserts itself freely; and representative human nature loves success and hates to be suspected of even the possibility of making a mistake. So it happens that municipal bodies accept and pass on without a qualm reports and accounts which no sane man, if they referred to his own affairs, or to affairs for which he was personally responsible, would delude himself with for an hour. These are some of the causes of the rapid increase in municipal indebtedness and in municipal expenditure.

I.E.E. Visit to America.

Mr. R. Kaye Gray, President of the Institution of Electrical Engineers, was entertained to dinner at the Engineers' Club, New York, on the evening of October 4th, when a presentation was made to him of a framed autograph portrait of Mr. Edison, as a souvenir of the last official visit of the British Institution to the Edison laboratory on September 22nd. Among those present were Messrs. Bion J. Arnold, President of the American Institute of Electrical Engineers; T. Commerford Martin, Chairman of the New York Reception Committee; J. W. Lieb, Frank J. S. Sprague, J. W. Wakeman and others, who had taken a special interest in the entertainment of the British Engineers. On the following day Mr. Gray sailed for England. Thus ended the official visit of the British Institution of Electrical Engineers to America, a visit which will long be remembered as marking an epoch in the cordial relations between the visitors and their American *confrères*. It would be impossible in a few words to do adequate justice to the lavish and unstinted hospitality of the hosts, the prophetic foresight with which they provided for every possible contingency, the untiring energy displayed in preparing for the entertainment and edification of their guests. It is well known that electrical engineers are the best of good fellows the world over, and our American colleagues are no less distinguished for their good fellowship than for their technical ability. They have laid their British guests under a debt of gratitude which the latter cannot hope to repay.

ELECTRIFICATION OF RAILWAYS.

The latest Blue Book containing the Board of Trade returns of railways has a most interesting introduction in the form of a general report, prepared by Mr. Llewellyn Smith. Some figures there given are such as to make those railway companies who are still doubtful of the necessity of electrification of suburban lines, pause to consider whether it would not be advisable for them at least to investigate the claims of electricity in connection with their suburban services. The following figures are very instructive :—

Railways.

Year.	Third-class railway passengers. (Year ended December 31st.)	Increase.	
		Number.	Per cent.
1896	888,604,000	—	—
1897	935,160,000	46,556,000	5·2
1898	963,674,000	28,514,000	3·0
1899	1,003,996,000	40,322,000	4·2
1900	1,038,873,000	34,877,000	3·5
1901	1,068,919,000	30,046,000	2·9
1902	1,080,625,000	11,706,000	1·1
1903	1,086,205,000	5,580,000	0·5
Tramways.			
1896	759,466,000	—	—
1897	788,570,000	29,104,000	3 8
1898	858 486,000	69,916,000	8·9
1899	924,820,000	66,334,000	7·7
1900	1,065,374,000	140,554,000	15·2
1901	1,198,227,000	132,853,000	12·5
1902	1,394,453,000	196,226,000	16 4
1903	1,681,949,000	287,496,000	20 6

From the above statement, it will be seen that since the year 1900, the number of tramway passengers carried per annum has exceeded the number of third-class railway passengers, also that the difference in numbers has been subsequently very largely increased since that year. Further, the increase in the number of tramway passengers during the latest 12 months for which returns are available, has been over 50 times the increase in the number of third-class railway passengers. It should be stated that the figures for 1893 include for the first time the traffic on such light railways as are laid on the public roads, but even allowing for this the figures are still remarkable, and demonstrate, amongst other things, how greatly the public appreciate any increase in transit facilities which may be offered them by electric tramways.

Within the last seven years the number of tramway passengers carried in the United Kingdom has more than doubled; whereas six years ago the number of passengers carried by tramways was considerably less than the total number of third-class passengers, at the present moment the position is reversed, and the number of tramway passengers exceeds by over 60 per cent. the number of third-class railway passengers. The tables we have given also show that whilst the third-class passenger traffic is practically stationary, the tramway traffic is growing by about one-fifth of its total volume every year. Considered from the point of view of the receipts, the figures are not so striking. The total gross receipts of tramways in 1896 were just over four millions sterling, whilst for the year ending 1893, these receipts had doubled, becoming, in round figures, £8,100,000, and the ratio of operating expenses to receipts in 1893, as far as tramway traffic is concerned, was 63 per cent. It must, however, be remembered that the capital invested in tramways is very small in comparison to that invested in railways, as shown by the figures contained in the two following tables, in which the tramways and railways are compared :—

Statistics of Tramways and Light Railways.

Year.	Route mileage.	Number of cars.	Total capital.
1898	—	—	£15,920,404
1899	—	—	£20,808,959
1900	—	—	£28,898,732
1901	2,237	4,611	£50,041,726
1902	3,116	5,528	£58,711,235
1903	3,584	7,343	£82,902,280

Railways.

Year.	Route mileage.	Capital invested.	Proportion of net receipts to total paid-up capital.	Ratio of operating expenses to receipts.
1896	21,277	£1,029,475,335	3·88 per cent.	56 per cent.
1897	21,433	£1,089,765,095	3·73 ,,	57 ,,
1898	21,659	£1,134,468,462	3·55 ,,	58 ,,
1899	21,700	£1,152,317,501	3·61 ,,	59 ,,
1900	21,855	£1,176,001,890	3·41 ,,	62 ,,
1901	22,078	£1,195,564,478	3·27 ,,	63 ,,
1902	22,152	£1,126,861,421	3·42 ,,	62 ,,
1903	22,435	£1,245,028,917	3·40 ,,	62 ,,

From these figures it will be seen that the capitalisation of railways is nearly 15 times that of tramways, whilst the route mileage of the former is just over six times that of the latter. At the same time, this is not a fair comparison, as in many cases there are single-line tramways, whilst there are a very large number of four-track railways. Whatever view may be taken as regards the necessity for the electrification of railways, there can be no doubt that the tramways are taking from the railways a very large amount of business which heretofore has been held by them, and as electric traction on tramways and light railways increases, the harder will the railway companies be hit.

Any advantage which tramways may have over electrified suburban lines must always be confined to short journeys, which will, in our opinion, never exceed 4 miles, and will probably not be more than 2 miles. To this extent we believe that railways, even if electrified, will have to yield to electric tramways, and acknowledge them as their superiors.

The very cause of the success of electric tramways, namely, their accessibility and frequent stops, will effectually prevent the average speed attaining any very high value, even should the Board of Trade sanction higher maximum speeds than it does at present. Thus it is often noticed that, owing to frequent stops of tramcars, and to the crowded condition of the streets, horse-drawn vehicles are able to proceed faster than the tramcars themselves, notwithstanding the very much higher speed which the latter can develop when the road is clear. These disadvantages will not apply to electric railways.

In comparing the positions of the railways and tramways, the former are in a far better position financially, for the reason that tramways, whether owned by companies or local authorities, have not only to pay interest on their capital, but also to lay aside sufficient money annually to pay off the whole amount invested in from 20 to 30 years. In the case of companies, their concessions are, by the Tramways Act of 1871, usually limited to 21 years, after which the undertakings can be purchased, practically at the value of old iron, by the local authorities.

In the case of municipal undertakings the conditions imposed by the Local Government Board specify a period in which the capital expended on the undertaking has to be repaid, but there are no such conditions attaching to railways, whose franchises are perpetual. The wear and tear of tramway tracks and the cost of maintenance are higher than would be the case with a railway, owing to the necessity of using grooved rails and the dirty condition in which the rails usually are. More power is required to propel a car on a tramway than on a railway, and the cost of maintenance under similar conditions is greater in the case of a tramway than in that of a railway.

It must also be remembered that the cost of electrification is proportionally greater in the case of tramways than of railways, for the reason that for tramways new tracks generally have to be laid, and in many cases widening of roads and strengthening of bridges undertaken, whilst the electrification of railways calls for no outlay in these directions. Another point in favour of railways is the smaller cost of laying feeder cables, for whereas in the case of tramways these have to be laid under the roads at a very great cost, railways can usually lay their feeders along the permanent way of the railway.

As regards rolling stock and generating stations, tramways and railways are very nearly on the same footing.

There are people even now who maintain that the electrification of railways in connection with their local services will not enable railway companies to regain the traffic they have lost through electric tramways. These sceptics should study the official figures recently published in the *Times*, giving the results of the Manhattan Elevated Railway of New York. We consider these figures of the greatest interest, in view of the fact that it is the first time that it has been possible to make a comparison between a year during which the line was operated entirely by steam and another year after it had been electrified.

Interborough Rapid Transit Co, New York.
Manhattan Railway Division.

—	Electric. 1904.	Steam. 1901.	Per car-mile. 1904.	Per car-mile. 1901.
Maintenance of ways and structures ...	$646,163·78	$406,739·72	$·01047	$·00927
Maintenance of equipment and power plant	818,372·84	571,851·56	·01325	·01304
Power supply and connecting transformation	4,013,979 69	3,967,516·11	·06501	09046
General expenses ...	367,534·78	307,122·16	·00595	·00770
Total operating expenses	$5,846,051·09	$5,253,229·55	$·09468	$·11977

It will be seen from this that the total operating expenses per car-mile have been reduced from 11·977 cents in 1901, to 9·468 cents in 1904, or in round figures, from 6d. to 4¾d. per car-mile, or a reduction of over 20 per cent. in operating expenses.

The two years, 1901 and 1904, given in this table are, respectively, the last year that the whole system was operated entirely by steam, and the first that the system had been operated for a whole year by electricity. The passengers carried and the receipts taken by the Manhattan Railway have also been most favourably affected by its electrification, as will be seen by the following figures:—In 1901, when entirely operated by steam, the Manhattan carried 246,587,022 passengers, and the ratio of operating expenses to receipts was 51·7 per cent. This year the number of passengers had increased to 286,634,195, and the ratio of operating expenses to receipts had been decreased to 41·2 per cent. The gross receipts of the company had been increased by $979,348.28, and the operating expenses had increased by $385,257.37, the increase in net earnings due to electrification being $1,594,090.91, and the total gross earnings for 1904 being $14,187,685.6.

It will, we think, be admitted that this is a very fine showing for electricity; especially when we bear in mind that when the Manhattan Elevated first decided to electrify, there were a great many people who were sceptical as to the results that would be obtained.

The steam service on the Manhattan Elevated was a magnificent one, as all those who know New York can testify to; the stations were at short intervals, and the service was a very frequent one indeed; furthermore, the surface roads of New York are all operated electrically, and maintain very high schedule speeds. The Manhattan Elevated, as its name implies, necessitates climbing a series of stairs to get to the trains, and descending the same after alighting from the trains, which, in the case of Americans, who hate undue exercise, when it entails waste of time on their way to business, should have militated against the success of this road.

The conclusions that can be drawn from the various figures given, are—

1. If electricity under unfavourable circumstances can produce the results cited on the Manhattan Elevated, in the case of suburban lines in this country, the results should be even more satisfactory.

2. Electric tramways, although at present serious competitors to the railways, will cease to be so if the suburban systems of the latter are electrified. When this is done electric tramways will be found of very great use in bringing traffic to and taking it from the various railway stations.

3. If tramway companies under unfavourable circumstances, owing to short franchises, can obtain the favourable results that they do, railways should do much better.

NOTES ON FAULTS IN SMALL LEAD-COVERED WIRES.

By DONALD SMEATON MUNRO.

Fault-finding is said to be easy, and perhaps that is why so much has been written about defective cables. So long as faults are common, however, examples have a certain general interest.

For interior wiring, to be connected to supply mains, there has, of late years, been a general tendency to surround insulated cables with a continuous and earthed metallic sheath.

One always feared that it might be a mistake to have conductors everywhere accompanied by their most dangerous enemy, "earth"; but, on the whole, it seemed better to run the risk of inducing more faults to get an arrangement

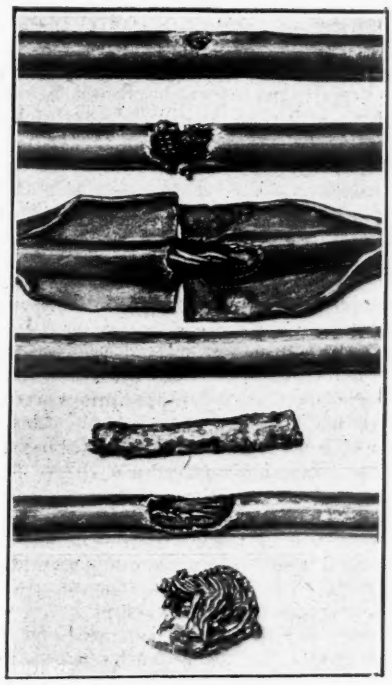


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.

Examples of Faults.

which made the fault, when it occurred, less liable to make a fire. Good iron and steel tube systems promised to secure this latter advantage—a promise by no means invariably kept in practice.

Solid lead, or other soft metal tubes or sheathing, can be fitted with much less cutting up of buildings, and fewer temptations to leave unprotected gaps in the metal covering. They also give a more equal protection to the insulation during and after erection, as against damp and mechanical injury; but such soft coverings have their own drawbacks.

A few years ago the writer had occasion to discuss these, and at that time described at some length certain practical inconveniences and dangers incidental to this mode of protection.

The dangers may be summarised as follows:—

Defects of Manufacture. — 1. Deterioration of dielectric by heat during the process of covering. Machines are often stopped for jointing and other reasons and portions of cable are thus subjected to prolonged heating. We are still without adequate information as to the effect of this upon the life, if not upon the immediate insulation, of the dielectric.

2. There is a temptation to use an inferior dielectric and rely on the protection of the lead.

3. Latent faults due to ends of broken strands, fragments of metal, &c., cannot be always detected by the tank or hydraulic test after the sheath is on. Yet these may be developed by handling while being fitted.

Dangers during Erection.—4. A careless workman is apt to injure the insulation while cutting off the lead cover where necessary.

5. The same kind of man overheats the covering while soldering or burning on at joint boxes and elsewhere.

6. Workmen usually overlook the minute pinholes made by the expansion of heated air bursting through the melted lead or solder when closing joint boxes, thus moisture gets in.

7. A very little pulling hardens lead tube and makes it brittle, so the tube is frequently cracked while being led through a building.

8. Trouble may be caused through pressure due to unsuitable or overtight saddles or other fixtures.

Disadvantages after Erection.—9. The lead gives little protection against mechanical injury, as from nails.

10. It is liable to attack by rats and mice.

11. A conductor of which the insulation has fallen cannot readily be pulled out for inspection. This is true even when the wires are pulled cold into soft metal tubing, as the flexibility of these tubes results in numerous bends and flattenings, which grip and hold the wires.

12. Lead expands when temperature rises, and being very inelastic does not go back to its original length when cooled, consequently conductors placed apart from each other or from other metals, may get into contact. In so far as the copper hinders this, lead covering is subjected to injurious stresses, and gets wrinkled and eventually cracked. Drawn lead is specially liable to this trouble.

13. As the electrical resistance of lead is considerable, contact with other metals may afford a better road to earth than the formal "earth wire."

14. When an "earth" comes on, the lead at the point of contact fuses as quickly as the proper fuse of the circuit.

15. Even pure water in the presence of air has a slight soluble action on lead.

16. The water from damp walls often contains dissolved salts of ammonia and other salts whose effects on lead are extremely deleterious.

17. Traces of decaying vegetable or animal matter under floors, produce acetic acid; this combines with the lead to form "white lead," which has a tendency to increase and eventually destroy the lead covering. Even almost dry wood suffices to set up this action.

18. Although the lead be removed for an inch or so where the conductors enter a terminal, in damp places the current creeps on to the sheathing and, escaping elsewhere, causes electrolytic corrosion.

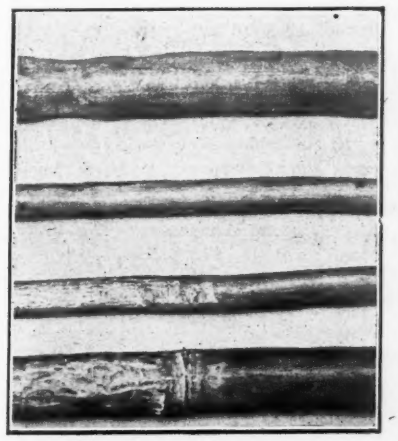


Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.

Examples of Faults.

19. Other metals—as brass saddles—cause electrolytic corrosion, if any moisture be present.

20. When a wire is in a roomy metal tube, the dielectric, except at points, includes the air between the cotton covering and the tube. The slope of potential, and, therefore, the stress on the dielectric, is much less than on a lead-

sheathed wire, where there is no intervening air. Wood casing is better than both in this respect.

It would be possible to add to this list, but, instead, a few examples of actual faults are illustrated. Figs. 1 to 4 and fig. 6 are taken from a private house fed at 250 volts by the negative and earthed "mid" of a three-wire public supply. They are twin 3/20 wires, covered with pure and vulcanised rubber, and taped; they are wormed circular, and are finally lapped with tape before being lead-covered. The rubber, after two years' use at least, is not very elastic, and is apparently of indifferent quality.

In fig. 1, a sharp-pointed wire nail, itself in dry wood, has pierced the lead and partly penetrated the insulation of the negative wire. In time the remaining insulation between the nail and the conductor broke down, and the current, entering the nail, passed from the lead to the negative wire. The appearance of the hole shows the direction of current. This fault burnt itself out.

In fig. 2, the appearance of one end of the broken strand indicates that there has been a fracture, so that heating took place at the point, broke down the insulation, and eventually arced from the lead. Here both wires became involved, and the marks characteristic of the direction of current are obscured by the more general melting of the lead.

In fig. 3, the insulation between the two interior wires had partially broken down, so that a slight current passed between them. The fault was discovered by the external warmth of the tube, and the latter shows no injury whatever except an internal coating of the charred material from the fault. In the photograph the lead has been cut open, and the charred rubber brushed away from the conductors to show the extent of the injury.

Fig. 6 bears marks of teeth, and there could be no doubt about the culprit, as his skeleton, with the spine tightly curled up, was found under the wire as illustrated.

Fig. 4 is taken from a portion of the tube, which was lying on a pine wood flooring joist. The corrosive action of the wood is clearly shown.

Fig. 5 shows a similar and more prolonged action. It is from a lead-covered cable laid in sand. Untarred boarding had been laid over the cable to protect it in the event of digging. The moisture saturated with the products of the decaying wood sank down to the lead and corroded it deeply as shown.

Figs. 7 to 10 are heavier lead tubes which were treated experimentally.

Figs. 7 and 8 were embedded in Portland cement and sand for 12 months. There is little, if any, sign of corrosion. The tubes are, however, reduced in diameter and partly flattened by the pressure of the cement in setting.

Figs. 9 and 10 were also embedded for part of their length, but in a mixture of what plasterers call first and second coating. They are distinctly corroded, but not deeply pitted. The action was greater near the surface of the plaster. These last four tubes were placed vertically in the substances in which they were embedded, the upper portions being left in air to afford a basis of comparison.

TWO IMPORTANT CONTINENTAL POWER STATIONS.

By A. STEENS.

A CENTRAL station, which will be one of the most important on the Continent, is in course of construction at Saint Denis. The machinery, which will be supplied almost exclusively by Brown, Boveri & Co., of Baden, comprises four Brown-Boveri-Parsons turbo-alternators of 5,000 KW. each, with a speed of 750 r.p.m. The alternators will supply three-phase current at a pressure of 5,000 volts with a frequency of 25 periods per second. Each group is provided with a surface condenser, the air and circulating pumps for which are worked by a continuous current motor.

The excitation current is supplied by a continuous current turbo-dynamo of 300 KW., running at 2,700 r.p.m., supplying current at a pressure of 200 volts, and provided with a condenser; and also by two motor-generators of 375 KW. each. A Tudor battery of 1,300 ampere-hours is provided as a stand-bye for periods when the steam installation is not at work and has to be started again. Its special task is to feed the continuous current motors working the feed pumps, and to act as a reserve for the excitation. Each turbine possesses a pump, which supplies oil under pressure to the various parts requiring it.

The turbines are constructed for a working pressure of 12 atmospheres, and for use with steam superheated to a maximum of 360° C. The vacuum in the condenser should not fall below 90 per cent. Under the above conditions the consumption of steam is 6·8 kg. per kilowatt-hour. The figures guaranteed are calculated very broadly, and the results of the trials will perhaps be still more satisfactory.

The dimensions of the central station will be at first 61·125 metres by 20 metres. Later on, however, the total length will be 96 metres with a view to the future addition of 10,000 H.P. units.

Another important central electrical station is rapidly being built at St. Ouen. This station, which will be one of the most important in France, will probably begin its work of distribution on January 1st, 1906. The machinery will be supplied, for the most part, by Brown, Boveri & Co., of Baden. In particular, there will be turbo-alternators of 5,000 KW. each, running at 750 r.p.m., and developing three-phase currents at a pressure of 5,000 volts, with a frequency of 25 periods per second. Each group is provided with a surface condenser. The air-pump and the circulating pump of each condenser, are worked by continuous current motors.

For excitation and local services, a continuous current steam dynamo of 300 KW., running at 1,700 r.p.m., with condenser, has been provided; also two motor-generators of 375 KW. each. These machines develop current at 100 volts for the excitation of the alternators and for the supply of continuous current to the various services worked from the station.

Accumulators are represented by a Tudor battery of 2,300 ampere-hours' capacity, serving as a reserve for the continuous current services of the station.

A central oil-pump, worked by steam, supplies oil under pressure to the various turbo-generators, in case any of the oil-pumps with which each turbine is provided are not in working order. The installation of switchboards and connections is undertaken by the same firm.

The steam turbines are constructed for a working pressure of 12 kg. They will work by steam superheated to a maximum temperature of 360° C. Tests will be made at a temperature of 300° C. The vacuum in the condensers must not be less than 90 per cent. Under these conditions, the consumption of steam should not exceed 6 8 kg. per KW.-hour.

REGENERATIVE CONTROL FOR ELECTRIC TRACTION.

A PAPER descriptive of Raworth's system of automatic regenerative control for electric traction was read by Mr. John I. Hall at a meeting of the Tramways and Light Railways Association, held at the Society of Arts on Thursday, October 20th.

The general features of the system, described recently in the columns of the ELECTRICAL REVIEW, were discussed by the author, and some results obtained in actual practice were given. In the paper, the author says the regenerative motor "is a series motor," yet, from the subsequent description, it is shown to have both series and shunt windings; and, in discussing the paper, Mr. Raworth described it as a shunt motor. It is really a shunt motor with an auxiliary series winding, and "the whole of the speed regulation," says the author, "is effected by the shunt field." This point was qualified somewhat by Mr. Raworth after the reading of the paper, and, from what he said, it would appear that a range of speed of 4½ to 14 miles per hour—a ratio of 1 to 3—is obtained with a 40 per cent. variation in the field strength. This statement is somewhat inconsistent. T

diagrams exhibited showed a variation of from about 2 to 6 amperes in the shunt current.

Among the advantages claimed by the author for the system are: (*a*) Economy in generating plant, due to the cars acting as generators during deceleration periods; (*b*) economy in feeders, owing to the better pressure distribution over the system; (*c*) economy in the consumption of energy; (*d*) economy in wear of brake shoes and wheels. No one will be inclined to question these general claims, but several electrical engineers present at the meeting expressed doubts as to the values given by the author to these economies.

It is not quite clear from the paper what it is that the author really claims. In one place, speaking of "current consumption," he says "an average of 25 *per cent.* in reduction can be obtained in operation." In another place, he says "the consumption as measured on the cars can be reduced by 25 or 30 *per cent.*"; and again "if operating solely on up and down gradients, an efficiency of up to 50 *per cent.* can be obtained." The extraordinary way in which "current consumption," energy, and efficiency are mixed up is confusing. But the author is as loose in the use of electrical terms as he is in his composition. In referring to some records taken at Devonport, he says "they were taken on a recording wattmeter by Elliott Bros. The areas were taken of current consumed and regenerated."

The results of the tests are then given in tabular form and expressed in "watts," the average being 6·846 "watts consumed," 2·043 "ratio returned," and 31·30 "*per cent.* returned." Now, the area of a recording wattmeter diagram is a measure neither of watts nor of current, nor is it correct to label the values of the energy returned as "ratio returned." The author considers that about 5 per cent. better than these figures would have been obtained had the motors been specially designed for the regenerative system. They were "converted series-parallel motors." Some tests taken by "Mr. Weaks" (the author means Mr. Weekes) showed "a return of 35·75 per cent. of energy in descending a gradient of 1 in 11." As the readings were taken on a "Vulcan recording wattmeter," the author considers 5 per cent. should be added, as motor meters have a bias in the forward direction, and therefore under-register in the "reverse direction."

This point was also amplified and emphasised later by Mr. Raworth. Replying to the criticisms which have been levelled at the regenerative system of working—namely, that the motors must be rated lower because they are always in active operation, either absorbing or delivering energy, whereas in the series-parallel system the motor has time to cool down when not driving the car—the author says that this does not apply on level routes. The reasoning is not conclusive, and we give the author's words:—"The series motor on level track requires, say, an amount of energy x to carry it from A to B. It does not matter how the energy is applied, the energy must be used and a corresponding heating effect is produced. The regenerative motor, on the other hand, requires to expend exactly the same amount of energy with, however, this exception, it performs its work in a much better way. It takes just the exact amount of energy at each second that is required. The maximum current is nearer the mean speed, a more even turning moment is secured throughout, and the strains and stresses on the system are decreased.

"In addition to this improved operation, in stopping, 40 per cent. of the energy required to accelerate to full speed is recovered, and the result is that the regenerative motor at the end of the run has performed the journey from A to B, by consuming x—x amount of energy, with the advantage that the heating effect has not been increased, because the average current throughout the time has not been greater than that required by the series motor."

What precisely is meant by "it takes just the exact amount of energy at each second that is required" is not quite clear, and the other expression, "the maximum current is nearer the mean speed," is also a little indefinite. Then in the second paragraph the author shows that 40 per cent. of the energy required to accelerate to full speed is recovered, but he does not seem to consider that this 40 per cent. cannot be obtained from the motor without some loss, which, of course, means heat.

The author then gives some definite figures on points of economy. A pair of series-parallel motors of about 30 H.P., costing about £150, would absorb about 45,000 units per annum, assuming that they run 100 miles a day on hilly lines. This, of course, works out to 1·5 units per car-mile, and at a cost of 1·5d. per unit, is worth £281 5s. To this the author adds the cost of the motors, namely, £150, making a total of £431 5s. for the year. (Why he should add the cost of the motors to the first year's energy bill, needs a little explanation.) He compares this with a pair of regenerative motors costing £170, and says "for this extra expense the motors can work all day long, and do 40 per cent. more work, and, at the same time, save 25 per cent. of energy required by the series-parallel system." Throwing in the 40 per cent. extra work done, the author shows that the saving on the first year's working of one pair of regenerative motors is £50 7s. 6d. The £20 is apparently added because a regenerative motor does more work than a series-parallel motor, although the author has been at some trouble to explain in a previous part of the paper that there is no need to take this into account. He subsequently explains that as series-parallel motors are not rated lower when the cars are fitted with "electro-magnetic brakes," there is no need to use larger machines for regenerative work, "so the saving of £50 7s. 6d. on the first year's work can be increased to £70 7s. 6d."

We are next treated to a little elementary arithmetic, the result of which shows that the cost of a pair of regenerative motors with energy consumption for 10 years is £2,259 odd, against £2,962 odd for the series-parallel system, a saving of £703 odd. The arithmetic is continued in order to show the saving for 25 cars, 50 cars, and 100 cars, respectively, the saving in the latter case approaching the magnificent sum of £70,312 10s.

Nor is this all. "Without going into details on this question," the author claims a saving of £10 per annum per car on brake blocks and mechanism; general car-shed labour and attendance, £5; wear and tear of cars, re-wheeling and trueing-up, £10; giving a total of £25 per annum per car, or £25,000 saved on 100 cars in 10 years. This is in addition to the £70,000 odd mentioned above, so, putting it roughly, the author calculates an approximate saving of £100,000 in 10 years on a system employing 100 cars, and this, it must be borne in mind, does not take into consideration the saving in the cost of generating plant, buildings, feeders, &c. For a scheme of this magnitude the author calculates that "the generating plant could be reduced by 910 KW., securing the remarkable economy of £15,000." "I have, however," he adds, "only taken the running plant into consideration; the stand-by plant could also be reduced."

The general impression of the technical men present was that the author had rather overdone the matter of saving, and Mr. Humphrey, engineer to the Isle of Thanet Tramways, forecasted the time when his generating station would be turned into a coal mine. The cars would generate the current, driving his engines, which, on the reversible principle, would put back energy into the boilers, with the result that coal would be delivered in a continuous stream from the mechanical stokers. He showed what, of course, every engineer present (except the author, apparently) knew—that series motors could be used to brake the car. In one part of the paper the author says, "No direct braking can be done by the motors on the series-parallel system," although he refers elsewhere to electro-magnetic brakes.

Mr. Sayers considered that a shunt motor had less accelerative power than a series motor, and therefore the average speed must be less. He considered that the cost of maintenance and upkeep would be greater for shunt than for series-wound motors. Mr. Raworth, replying to this point, gave figures as to maintenance, and undertook to pull Mr. Sayers off his feet by the acceleration of one of his demi-cars.

Mr. Mordey reminded the meeting that Mr. Siemens outlined the system of regenerative control in that same room as far back as 1881; he also referred to his pet subject of alternating current traction, showing that regenerative control was easier on that than on the continuous-current system. He referred to the Swiss mountain railways, which work on the regenerative principle, but he omitted to inform the meeting that the regeneration, so far as putting energy back to the line was concerned, had been practically abandoned on the Jungfrau line, owing to the enormous fluctuation produced on the generating plant, and that the regenerated

energy is now wasted in resistances. This fact might appear to tell against the claim for regenerative tram control, that the load on the generating plant was equalised, but the conditions of a tramway system and those of the Swiss mountain railway are very different. In the one case we have a very few trains with powerful locomotives, and in the other case a large number of cars with comparatively small motors.

Mr. Sydney Sharpe also spoke and called attention to some discrepancies in the figures given in the tables.

In his reply, Mr. Hall said that 25 per cent. saving in energy consumption had been shown at Devonport, and that as regards maintenance, the report from Southport showed that there was less trouble on the regenerative cars than on the others; and as to sparking, so long as the field current was 3 per cent. of the armature current, the shunt motors did not spark.

LIABILITY FOR TRAMWAY ACCIDENTS.

[By our Legal Contributor.]

The recent deplorable accident to an electric tramcar at Stalybridge, as a result of which several persons were severely injured, naturally turns attention to the question how far a tramway company is liable to compensate those who are injured. The matter is one of considerable importance, inasmuch as the disablement of a professional man with a large practice, or a business man in a large way of business, may give rise to a claim for a large amount.

Primâ facie, of course, a tramway company undertakes to carry passengers safely, and in order to fulfil that obligation it is necessary for the company to employ competent drivers and conductors. This is because the company is liable for the consequences of negligence on the part of those whom it employs.

Sec. 55 of the Tramways Act, 1870, provides that the promoters or lessees of a tramway, as the case may be, shall be answerable for all accidents, damages and injuries happening through their act or default, or through the act or default of any person in their employment, by reason or in consequence of any of their works or carriages, and shall leave harmless all road and other authorities, companies or bodies, and their officers and servants, from all damages and costs in respect of such accidents, damages and injuries. It may be observed, in passing, that the section applies only to a wrongful act or default, and does not make the promoters or lessees answerable for a mere accident caused by their use of tramcars (Brocklehurst *v.* Manchester Tramways Co., 1886, 17 Q.B.D. 118). Thus it is probable that an accident caused by the breaking of an axle, owing to a flaw which could not have been detected, would not found a claim for damages.

Most, perhaps all, tramway companies protect themselves as well as they can from incautious conduct of their employés by a series of minute detailed instructions put into print and distributed amongst them, particularly to drivers and conductors. When this is done, although such instructions will not relieve a company from liability for acts and or default of an employé contrary to his instructions, if he is within the scope of his duties, yet they will be strong evidence as showing what exactly is the extent of the office or the duties of the particular servant whose acts or default are complained of. Accordingly in one case, where a conductor detained or gave into custody, contrary to his printed instructions, the plaintiff on an unfounded charge of passing bad money, the defendant company was held not liable (Charleston *v.* London Tram Co., 36 W.R., 367.) In another case, where the facts were very similar, but there were not such printed instructions, the company was held liable (Furlong *v.* South London Tram Co., 48 J.P., 329). The extent of a tramway company's liability may be gauged by reference to one or two cases. The damages recoverable by a person injured in a railway accident are, in the first place, any actual pecuniary loss he may be shown to have suffered; secondly, if the injury is such as to disable him from following his profession, the jury should be directed to give such a sum as considering all the circumstances of the case will be a reasonable compensation. The fact that a person injured has a large private fortune ought not to go n diminution of the damages, but it should be taken into account in considering the probable duration of the professional income, the chances of retirement, and so forth (Phillips *v.* L. & S.W. Ry. Co., 5 Q.B.D. 78). The damages, moreover, are not subject to any deduction on account of money received by the plaintiff from an insurance office under a policy of insurance against accident (Bradburn *v.* G.W. Ry. Co., L.R. 10 Ex. 1).

In view of the fact that liability cannot be wholly avoided by the selection of competent motormen and conductors, tramway undertakers are compelled to take other steps for the purpose of diminishing their liabilities as far as possible. As we have seen, the Tramways Act of 1870 imposes a certain liability upon them. Can that liability be modified or lessened by special agreement with a passenger? A tramway provisional order generally provides that the tolls for passengers shall not exceed one penny a mile, and sometimes requires workmen's cars to be run, between certain specified times, at fares not exceeding a half-penny a mile. If a passenger is carried at the statutory rate, it is conceived that the undertakers can have no right to issue to him a ticket which in any way purports to curtail their liability to him. There are no reported cases relating to tramways which bear upon the question; but some of the cases relating to the issue of railway tickets subject to conditions.

As a general principle, it may be stated that a person taking a ticket has notice of conditions appearing on its face, or referred to thereon, and he is bound by such conditions so far as they are legal, whether he actually reads them or not (Watkins *v.* Rymill, 10 Q.B.D. 178). The decided cases show: (1) Conditions actually printed on the face of the ticket are binding, whether read or not; (2) If the ticket is in the form of a book with coupons, the passenger must be taken to have notice of conditions inside the cover, though not referred to on the cover (Burke *v.* S.E. Railway Co., 5 C.P.D. 1); (3) If the ticket on the face of it states that there are "conditions" on the other side, or if the passenger, in fact, knows that there are conditions on the other side, he is bound by them whether he reads them or not.

If the ticket on the face of it merely contains the words "See back," and the passenger does not know or believe that any conditions are referred to, or are written on the back, it appears to be a question for the jury whether the company has done everything reasonably necessary to bring the conditions to the passenger's notice (Parker *v.* S.E. Railway Co., 2 C.P.D. 416). *A fortiori*, where a ticket is complete on the face of it, and contains no reference to anything, a passenger who is shown, in fact, not to have been aware of the conditions on the back, is not bound by them (Henderson *v.* Stevenson, L.R. 2, H.L. 470).

The above cases go to show that a tramway company may bind a passenger by conditions printed on the back of a ticket; but such conditions must be justifiable in law.

With a view to limiting their liability for accidents to passengers, the Sheffield Corporation have printed the following statement on the back of their tramway tickets:—

Important Notice to Passengers.

Passengers are being carried at less than the maximum authorised charges, and every passenger is notified that, in consideration thereof, a passenger is only carried on the terms that the maximum amount recoverable from the Corporation on account of any injury or damages suffered by a passenger, and for which the Corporation is legally liable, is £25. Except as above, every passenger travels at his own risk. Passengers can only travel subject to being bound to observe the bye-laws for the time being.

The front of the ticket contains the usual information, with a foot note "See other side."

It is interesting to consider this notice in the light of the principles of law, which we have set out above. In the first place, it will be seen that the Corporation claim to exercise the right of limiting their liability owing to the fact that they are carrying passengers at less than the statutory rate. What bearing has this upon the question? There is nothing to show how far the statutory fare does exceed that which is actually charged; but this, in our view, appears to be immaterial. To use the English version of a Latin legal maxim, "that is certain which is capable of being rendered certain"; and, if called upon to substantiate their statement, the Corporation could do so at the proper time. The passenger who, by reason of the notice "See other side," may be proved

to have notice of the special terms and conditions which are printed on the back, may be taken to agree to travel, subject to those special terms; if he does not agree to do so, he may get out and walk. But to consider the question in all its bearings, could the Corporation refuse to allow a passenger to travel if he refused to accept the terms upon which they offer to let him have a ticket, and simply tendered the legal fare? In other words, can the Corporation discharge the statutory duty of allowing passengers to travel at a certain rate, namely, that of one penny per mile, by charging only a portion of that rate, and by exacting the balance by reducing their liability for accidents? We cannot find any section in the Tramways Act, or any clause in the customary form of tramway provisional order which throws any light upon the solution of this question. Nor does there seem to be any case reported which shows that the question has ever arisen either in connection with tramways or with railways. Having regard to the fact that an electric tramway is worked under statutory authority; that it is worked for the benefit of the public; that the laying of rails in the streets, and the continual passage of cars along those rails is a source of some inconvenience to those who use the streets, it is conceived that the tramway undertakers are under an implied obligation to carry the public at the legal fare, or at any rate, to give every member of the public the option of being carried for that fare. Although the matter is by no means free from doubt, general principles of law seem to make it unsafe for the tramway company to prescribe the way in which the Parliamentary rate shall be paid.

When railway companies issue return tickets at cheap rates, they do so upon certain conditions, which may or may not include a condition as to some limitation being placed upon their insurance risk. If a person desires to make a journey for which cheap tickets are issued, he can do so either at the reduced rate or upon the terms of paying 1d. a mile. He has the option. If he thinks that by paying the Parliamentary rate he will get better value for his money he can do so. The Corporation of Sheffield, however, who issue tickets on the conditions above set out, do not (so far as we know), give their passengers any option. It is Hobson's choice—"This or none." The passenger must accept the ticket offered to him with all its conditions. If he refuses to accept a ticket subject to any condition the Corporation, it is understood, claim the right to summon him for refusing to pay the amount.

No doubt, the Corporation in question have taken a high opinion upon the question whether their course of procedure is lawful or not. The matter is so doubtful, however, that until it is definitely decided in the Courts, no company ought to take the step without due consideration. In the first place, it is not clear that it is legal to issue a ticket subject to any conditions of the kind which have been discussed. In the second place, the legality of such a ticket is rendered still more doubtful by the fact that the passenger has no option but to accept it. It is hoped that a test case may soon arise which will put the matter on a settled basis.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"N.C.W." writes:—"I have a rather singular case which I think might be of interest to your readers, and which I would esteem it a favour if you would give your opinion upon in the 'Legal Query Column.'

"A orders two motors from B (who is a merchant) under contract as to date of delivery and performance. B informs A where motors are being made, and asserts that he is agent for the factory of C. A inspects the motors in progress at C.'s factory. B breaks contract as to delivery. A telephones C, and purchases direct one motor in place of one that was to come from C *via* B. The other motor being made by C and ordered *via* B arrives a month overdue and then proves a total failure. C is employed by B to rectify under agreement as to time given to A and B. C breaks this and the order is finally cancelled by A, and B and C accept cancellation in writing. Meanwhile A has sustained serious loss through negligence of C. A claims damages from B. Meantime C claims settlement of account from A for motor supplied direct.

"Is A justified in withholding payment to C until A receives compensation from B who presumably likewise claims compensation from C, the whole damage having been occasioned entirely through C.'s negligence, or, apart from above,

"Can A claim from C payment for expenses incurred in carrying out experiments suggested by C to rectify the motor, all of which are a failure?"

*** Dealing first with the agreement made for the supply of two motors, it is clear that A came to know shortly after the contract was made that B was only acting as agent for C. In these circumstances, A must elect whether to charge B or C with the fulfilment of that contract. In the circumstances of the case he would be well advised to look to C alone, and if C claims a settlement of account for the motor supplied direct, it will be competent for A to counterclaim for damages, and the whole question can then be settled in one action. With regard to the expenses incurred by A in endeavouring to put the motor right, it is conceived that these might be claimed by way of special damage. In the circumstances, A should see his solicitor.

THE ELECTRICAL CONTRACTORS' ASSOCIATION (INCORPORATED).

In our last issue we referred briefly to the meeting of this Association, which was held at Frascati's Restaurant, Oxford Street, W., on Tuesday, October 18th, for the purpose of considering the report of the central board, and the transaction of the ordinary general business of the Association. We are now able to give a fuller report of what took place.

There were present Mr. W. R. Rawlings, supported by Messrs. Hogan, Marryat, Berry, McDermott, Cross, Martin, Woodward, Usher, Wallis, Steinthal, Joseph, and a number of other gentlemen.

Mr. Rawlings, in opening the meeting, welcomed the representatives from Ireland, Scotland, and the provinces, to London. The Secretary then read the minutes and notice of meeting, which were confirmed.

The President, in his report, recounted the earlier history of the Association, the negotiation and agreement with the manufacturing houses, and urged members to act loyally to the agreement. He eulogised the work of the Joint Committee, and incidentally mentioned the establishment of a branch, and the opposition to the Sheffield Corporation. He dwelt at some length on the reconstitution and the incorporation, together with the aspirations of the Association, and explained the composition of the central board, sectional boards, and local branches, and the responsibility of members in making the Association a success.

The Treasurer then presented his financial statement, showing the deficit of £165 10s. 6d. This, he explained, was more apparent than real, as the subscriptions due on May 1st last had not been called in yet, and, when they came to hand, would pay all outstanding accounts, and leave a balance in hand of about £100. The President spoke confirming this statement.

Mr. Martin, of Glasgow, moved the adoption of the balance-sheet as presented. Mr. Wallis, of Leeds, seconded, and the motion was carried unanimously.

Mr. Steinthal then proposed that the subscriptions for members of all classes should be two guineas per annum, and that the entrance fee for members and fellows be two guineas, and the entrance fee for associates be one guinea; these to be fixed amounts. Mr. Woodward suggested the probability of their being a big balance in hand at the end of the year and proposed, with the idea of introducing new blood, that the entrance fee be one guinea to all classes, and that subscriptions for all members, fellows, or associates be one guinea also. The President replied, pointing out the expenses to be met, such as the salary of the permanent secretary, and other outgoings. Mr. Steinthal's motion was carried with two dissentients.

Mr. McDermot then moved: "That this meeting accept the recommendation of the Central Board and confirm the purchase of the *Electrical Contractor* for the sum of £200." Mr. Berry seconded, and the motion was carried unanimously.

Mr. Berry proposed that Messrs. Cross, Steinthal, Hogan, and Marryat be elected honorary fellows. Mr. Noble seconded it, and the motion was carried by acclamation.

Mr. Shaw then moved that Messrs. Rawlings, Berry and McDermott be elected honorary fellows. Mr. Martin seconded. Mr. Joseph moved an amendment to the effect that they be elected simply fellows, but this was not seconded. The honorary solicitor, Mr. R. Tweedie Smith, then explained the difference between fellow and honorary fellow, and the difference in other grades.

After further discussion Mr. Martin proposed that Messrs. Rawlings, Berry, McDermot and Wright be elected honorary fellows. Mr. Shaw seconded. The motion was put to the meeting, but as it was not unanimous, Messrs. Rawlings, Berry and McDermot refused to accept the honour. With regard to Mr. Wright, Mr. Martin undertook to inform him of the motion, and no doubt he would signify his acceptance or otherwise.

Mr. Berry then proposed that Mr. Woodward be elected a fellow. Mr. Rawlings seconded, and Mr. Cross supported. The motion was carried unanimously.

The following reports from the Sectional Boards were then taken:—For London, Mr. Hogan spoke on the excellent progress of the Association, and Mr. Berry continuing the same subject, eulogised the work of his predecessors, and gave a glowing description of the future prospects. For Manchester, Mr. McDermot reported progress, and gave details of the large fire in Manchester; he produced Press reports thereon, stating that a large number of fires attributed to fusing, did not arise from that cause at all, and that it behoved all branches of the Association to investigate all fires attributed to electricity to take strong and immediate action, and to see that the Press reports were correct, as sufficient harm to the industry had already been accomplished by false reports. For Glasgow, Mr. Martin reported and expressed his gratification at the spirit he had seen displayed; he mentioned the Association's opposition to the Glasgow Corporation, their conference with the consulting engineers of Glasgow, and the favourable result thereof.

Mr. R. Tweedie Smith then gave a very interesting address on the subject of "Municipal Trading," defining the sphere thereof. He said that no Corporation should enter into competition with private enterprise where the latter was sufficient for the purposes concerned. He referred to the Stoke Corporation, and to the stopping of the contracting department, and to the necessity of contractors co-operating by canvass. He referred to the efforts with respect to Newport and Ayr. He pointed out that the municipalities were in debt to the extent of £146,000,000, which had been devoted by them to the purposes of municipal trading. He dwelt at some length on the Leeds and Battersea Corporations, and the danger of Tammany in municipal life, and referred to the necessity of enthusiastic backing of the Association's efforts to defeat the London County Council Bill shortly to be placed before Parliament. Mr. Rawlings supported these statements. Mr. Woodward moved that the Association oppose municipal trading in so far as it affected the electrical profession. Mr. Wallis seconded, and the motion was carried unanimously.

The President then referred to the publications of the Association, namely, the "Model Specification" and the debt-collecting letter. He then read a letter from the Manufacturers' Association, giving notice to terminate the agreement on December 31st next, and urged the members to act up to the spirit of the agreement, taking into account the monetary advantage accruing therefrom.

Mr. Berry proposed, and Mr. Cross seconded, that the Central Board be instructed to inquire into the possibility of establishing a contractors' supply house, or make some other arrangements in the event of the notice from the Manufacturers' Association being confirmed. Mr. Berry commented on the sacrifice which members of the Central Board had to make for the benefit of the members of the Association generally, and briefly explained the working of the Joint Committee.

A vote of thanks to the President and to Mr. R. Tweedie Smith concluded the business of the meeting.

DINNER TO DR. LEE DE FOREST.

On Tuesday evening last a dinner was given at the Hotel Cecil in honour of Dr. Lee De Forest, on the eve of his departure for America, by Mr. Franck Z. Maguire, vice-president of the American De Forest Wireless Telegraph Co. Sir W. H. Preece presided, and there were present many prominent scientists, telegraph engineers and journalists, including Sir Dudley Forwood, Admiral Sir J. D. Hay (Reuter), Col. H. C. L. Holden, Capt. Lionel James (*Times* war correspondent), Lieut. Balmson (Great Northern Telegraph Co.), Profs. W. E. Ayrton and G. M. Minchin, Messrs. James Swinburne, A. A. Campbell-Swinton, S. Barber (Anglo-American Telegraph Co.), F. C. C. Nielsen (Great Northern Telegraph Co.), A. L. C. Fell, H. W. Sullivan, G. R. Neilson (European and Azores Telegraph Co.), J. H. Carson (Anglo-American Telegraph Co.), Nevil Maskelyne, E. H. Johnson, and C. Moberly Bell (*Times*), the company numbering nearly 70.

After an excellent repast, the Chairman briefly proposed the healths of "The King" and "President Roosevelt," and afterwards the guest of the evening, Dr. Lee De Forest. Sir W. H. Preece referred to his own 52 years' connection with electrical engineering, and told of his bringing the telephone to this country. His own work in wireless telegraphy began 20 years ago. He recalled the arrival of Mr. Marconi, and dwelt at some length on the assistance afforded to him by the Post Office authorities, and on the subsequent development of wireless telegraphy, concluding with a eulogy of Dr. Lee De Forest, whose system had done such good work in the Far East in the hands of Captain Lionel James, special correspondent of the *Times*.

In his reply, Dr. De Forest referred to the splendid work done in connection with submarine telegraphy by British engineers, and expressed the view that wireless telegraphy would become the handmaiden of the cable. He then reviewed the history of the system, which he thought had made more progress in the last 12 months than during any previous period. The *Times* wireless war service was the first successful utilisation of wireless telegraphy in journalistic work; from a boat equipped with 96 ft. of antenna wire, and a 1-kw. transmitter, messages up to 1,700 words in length were transmitted over distances up to 210 sea miles, at the rate of 25 to 35 words per minute, often in the face of messages from warships of several nationalities. In America, permanent wireless communication had been established over 180 miles between Buffalo and Cleveland. At St. Louis Exposition 10 installations were established, handling 3,000 to 5,000 words per day; communication was also established on September 14th between St. Louis and Chicago, 300 miles overland, and right across the City of Chicago, and since then services had been inaugurated between St. Louis and Kansas City and Springfield, distances of 280 and 105 miles respectively. Thanks to the methods of tuning employed, there was no interference between the local St. Louis service and the long-distance transmission. Several other services were working or in course of installation, between the principal cities of the United States; cable service, in code, was successfully handled, and between St. Michael's, Alaska, and Cape Nome, where the ice rendered a cable impossible, all cable messages from the United States were transmitted by wireless telegraphy over 105 miles of sea. The U.S. Navy had just granted the American De Forest Co. contracts under penalty for the establishment of five stations in southern waters, over a range of 1,000 miles. A wire between St. Louis and Chicago would cost £18,000, whereas the wireless stations had cost £3,000 all told, and all maintenance, &c., was confined to the two stations. There was a great future before the art, if developed on sane and rational business lines, and it would be of the greatest value as a feeder to the cable and the telegraph wire.

The Chairman then toasted Captain Lionel James, who, in reply, gave an interesting account of his experiences in the Far East with the De Forest system. The *Times* service came to an end because it was so much superior to that of the Japanese, who could only telegraph over 100 sea miles. He had telegraphed messages 800 words in length over 240 sea miles in one operation, at 20 to 25 words a minute, and on subsequently comparing his original MS. with the message received, there was not one mistake. A greater trial consisted in successful transmission in both directions over the whole length of the Shan-Tung peninsula, across hills 2,000 ft. high. There was an element of danger to belligerents in wireless telegraphy, and the sooner international legislation was carried out, the better it would be.

Prof. W. E. Ayrton proposed the health of Mr. F. Z. Maguire, who expressed his pleasure at the presence of so many prominent scientific men, and representatives of the leading cable companies. He briefly recalled the difficulties with which the phonograph, telephone, &c., had to contend in their early days, and considered that wireless telegraphy had been developed far more rapidly; the system had now reached a high degree of reliability, and the success of Dr. De Forest's demonstration in the presence of the Post Office authorities, between Holyhead and Howth, last year, was well known. Spanning the Atlantic was of less importance than the successful transmission of messages over distances of 300 to 500 miles.

Mr. S. Barber, proposing the health of the Chairman, unofficially expressed the intention of the cable companies to make use of wireless telegraphy, which they regarded not as a rival, but as a valuable auxiliary. The Chairman suitably responded.

The proceedings were intentionally informal, and passed off with great satisfaction to all concerned.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Intercommunication of Tramway Systems.

Mr. Arthur Day's remarks in your issue of the 14th inst. in respect to running powers in conjunction with the South Lancashire Tramway system remind me somewhat of a very loyal valet who was instructed by his master to give an equivocal reply to any callers who might want to see him. The first caller who asked the valet if his master was in, was favoured with the reply, "Is your grandmother alive;" the caller's grandmother not being alive, he concluded that the gentleman whom he had come to see was not in, and left the matter there. The only difference in Mr. Day's case is that my grandmother is very much alive, as will be gathered from the following answers to Mr. Day's replies to your leaderette.

The first question Mr. Day asks is, what evidence is there for the statement in your leaderette that the receipts on both the Corporation's system and also upon my company's system during the time when there was an exchange of cars, far exceeded those previously obtained, and the following extracts from the *Bolton Evening News*, dated April 11th,

1903, and the *Bolton Weekly Chronicle*, dated April 18th, 1903, will, I trust, be regarded as sufficient :—

Bolton Evening News, April 11th, 1903.

By arrangement with the South Lancashire Tramways Co., through cars were run from Great Moor Street to Atherton, Leigh and Bolton. The fare was 1s. return, and the scheme, which was tried as an experiment, proved a complete success, thousands of people travelling to Lowton and intermediate places, some for the first time in their lives, by car.

Tremendous Tram Traffic.

During the day the tram traffic was phenomenal, all previous records paling into insignificance with the tremendous number of passengers carried yesterday. The receipts were the highest on record by nearly £200, and it is safe to say that they were not so high as they would have been had the supply of cars been equal to the demand. The number of cars available was quite inadequate for the amount of passengers. This fact was evident on all the routes, but more especially on the Chorley Old Road and the New Road services. No fewer than 15 cars were engaged on the New Road service, but these were quite inadequate for the extraordinary traffic, and the scene at Great Moor Street will not readily be forgotten. Hundreds of people assembled at the starting places, only, however, to find the cars already filled. It was, indeed, an exceedingly busy day for the tramway officials all round, but especially for the conductors.

The amount taken on all routes during the day reached no less a sum than £715, which shows an increase of £249 over the corresponding day last year, when the receipts were £466, and £148 more than the previous highest record for any one day since the Corporation took over the trams—the previous highest amount, £567, taken on Coronation Day. The traffic for the week (including yesterday) shows an appreciable increase of £435 on the previous year.

The amounts taken on the various routes were :—

Chorley New Road ...	£213	Tonge Moor	£50
Chorley Old Road ...	50	Deane Road	20
Halliwell	50	Gt. Lever	12
Dunscar	100	Breightmet	15
Farnworth	85		
Daubhill	120		£715

The *Bolton Weekly Chronicle*, April 18th, 1903, says :—

The tram traffic on Good Friday was extraordinarily heavy. In addition to the other routes, a through service was run in connection with the South Lancashire Tramways to Lowton, *vid* Four Lane Ends, 6d. paid for the journey, and thousands tried and enjoyed the journey. For the best part of two hours there was a big struggle for seats, and both parties to the experiment undoubtedly did well as a result of their enterprise. At times the crush for seats or even for standing room on the Horwich and Lowton cars—and it was the same on the return journey—was distressing, and people with young children had no chance whatever. It appears to us that the police in conjunction with the tramway officials might render very useful service.

The receipts amounted to £713, or £150 in excess of any previous day.

If Mr. Day is in a position to dispute the statements contained in the extracts above quoted, perhaps he will be good enough to let us know upon what dates the receipts upon the Bolton Corporation tramway system had previously exceeded those referred to, and by how much. Assuming that the information given in these extracts is correct, then I should like to know in what respect the service in the town was interfered with, and how the Corporation lost money. I venture to think that the difficulty with the service was created entirely through the unfortunate position which the Bolton Corporation were in, in not having at the time sufficient cars as referred to in the above extracts, and, further, even under such conditions, I think had Mr. Day then been general manager, that matters would have been from that point of view considerably improved; not that I wish to cast any reflections upon the then manager, but I have always felt most strongly that an engineer is more fitted for the management of an electric tramway undertaking than any other person can be.

However, I am, with you, more than delighted to know that the Bolton Corporation are now anxious to run in conjunction with any neighbouring authority, and I shall lose no time in endeavouring to come to some such arrangement with Mr. Day. I feel some little uneasiness, however as to whether Mr. Day in his letter to you does not mean to confine his anxiety for such an arrangement to "local authorities" only, as the word "authorities" in his letter may be considered to imply.

I would only add that in 1903 my company sought for powers to form junctions with any other tramways or light railways which could be worked in connection with our own tramways, and the following is a copy of the Clause (42) which is in our 1903 Act :—

The company may form junctions between any of their tramways and any tramways or light railways which can be worked in connection therewith, but only with the consent of the owners and lessees of such tramways or light railways, as the case may be, and of the local authority in whose district the junction is to be made. Provided that such consents shall not be unreasonably withheld where any such junction is for the public convenience, and in case of difference the matter shall be referred to the Board of Trade for determination.

It will be seen that all this clause seeks is for power to make junctions with other tramways with the consent of the owners of such other tramways and of the local authority, and if such consents are unreasonably withheld where such junctions are required for the public convenience, *the matter shall be referred to the Board of Trade for determination;* Mr. Day in his letter assures us that he can prove to any person who is open to conviction that if running powers with neighbouring authorities are not adopted by them, no reasonable person could expect them. Having regard, therefore, to the fact that the junctions sought for in the clause above quoted must be for the public convenience, and that the onus lies upon us to show the Board of Trade (which, I presume, Mr. Day will admit is an independent party open to conviction) that such junctions are required for that purpose; I should like to know how he reconciles his contention with the special clause which the Corporation caused us to insert in the same Act, of which the following is a copy :—

35. Nothing in this Act contained shall authorise the company to construct any junction between any of their tramways and any tramway of the Corporation other than such junctions as are already authorised.

It will be seen from this that the Bolton Corporation have excluded themselves from the operation of Clause (42) above referred to, and not, mind you, because we wanted to force ourselves into Bolton, but because we wanted these junctions only, if and when we could prove to the Board of Trade that they were required for the public convenience.

I must apologise for the length of this letter, but inasmuch as Mr. Day has asked for the matter to be dealt with in common fairness to both sides, it is as well that the whole position should be considered from both sides. If necessary, I could extend the matter to cover the negotiations between us in regard to the joining up of their existing tramways with our own, which again would not show that the Bolton Corporation were then animated by that anxiety for through connections which Mr. Day would now have us believe.

J. R. Salter,
General Manager, South Lancashire Tramways Co.

Liverpool, *October 18th*, 1904.

A Mysterious Discharge.

Referring to Mr. Eden Green's article published in your last issue, some years ago I noticed similar phenomena on two occasions, both of which occurred when erecting overhead mains at collieries. In the first instance the insulated mains passed over the boilers, which were outside, the mains being fixed at one side on ordinary insulators on the pit head framework, and at the other side on the chimney stack in the same manner, then run down into the engine room; their height above the boilers was about 10 ft.

Previous to the mains being connected up to the dynamo they were lying on the engine room floor; when I lifted them up by the bared ends I got a shock, and could also get a discharge when bringing the ends near parts of the engine, which was earthed. I found that this was due to the steam blowing off from the boilers. In the second case, whilst fixing bare conductors to insulators on a post, a locomotive commenced blowing off steam under the conductors further back, with the result that I nearly fell from the ladder with the shock I received. The above are, of course, practical demonstrations of the well-known Armstrong hydro-electrical machine.

I do not think that the galvanised iron ledge had anything to do with the discharge, as Mr. Eden Green appears to suggest, excepting that the cable was probably discharging to earth at that point.

E

It is obvious that the sparks would be longer and brighter on a dry day than a wet one.

It would be interesting to know if there was any steam about on this occasion, otherwise it would appear from the sudden disappearance of the phenomena that it was due to some atmospheric condition.

C. McC.

London, *October 22nd*, 1904.

Referring to the letter under this heading in your last issue, it may be of interest to mention a similar phenomenon I noticed on two occasions when in South Africa. The first was during the time I was on an armoured train. A stranded wire, with insulating covering, went from end to end of the train. This was attached to the cock of the whistle on the locomotive in the centre of the train, so that an alarm could be sounded. I noticed, one evening, a continuous succession of bright sparks between the wire and the dome of the locomotive, at a point where the insulation was evidently impaired. The train had been stationary for some hours, but the safety valve was blowing off.

The second occurrence was at one of the military hospitals at Bloemfontein. Sparks could be obtained from the overhead wiring of the lighting plant, before it was connected up. But there was no steam jet within two miles of the place.

Your explanation seems to be a feasible one as regards Mr. Eden Green's bare *wire*, but I cannot quite see how his *insulated* cables could have got charged "through a current of air which had received a charge from a steam jet, or from some similar source."

G. R. Pepper.

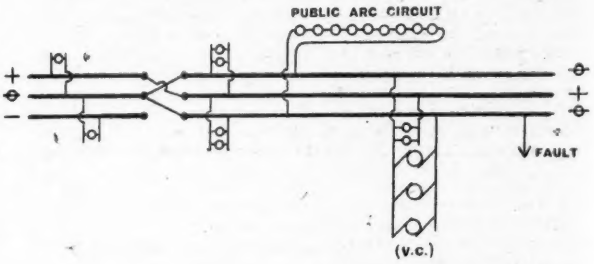
London, S.W., *October 25th*, 1904.

[See previous letter. Electrostatic induction would account for the effect in the case of the insulated cable.—EDS. E.R.]

Groves: Localisation of Faults.

I was sorry to find that Mr. Groves regards my inquiry as "flippant criticism." Had Mr. Groves mentioned in his paper that the idea was to temporarily transform the three-wire section into a two-wire one, even I could not have misunderstood his meaning. In extraordinary or prepared cases this is all right, but to mention it in a paper as a good plan to be acted on in case of any fault on any section of distributors is rather absurd. About six years ago I saw this done with success on a fault, but the fault was on an end section up a side street, with two consumers on one side and one on the other—all of them with incandescent light installations. When the Wigan Corporation started a supply all the mains were laid and consumers balanced and connected before the permanent station was even built. The whole town was therefore supplied on the two-wire system, with temporary plant, by connecting the two outers together. In Partick and other places at the present time there are large installations working on the two wires when supplied by private plant, but when switched over to the Corporation mains they are divided up on the three-wire system. The above cases are exactly the same as pointed out by Mr. Groves, and I only mention them to show that even to my small experience the arrangement is rather archaic. This being the case, I hardly thought Mr. Groves was referring to it in an otherwise original and instructive paper, especially when he mentions the "risk of breaking lamps" in connection therewith. I still fail to see where this risk need come in! To return to the offending paragraph (which Mr. Groves admits was ambiguous) corrected, it now suggests that after we have connected the faulty section up as a two-wire one, we must not leave the meter, &c., working backwards, as in the original, but should go from door to door, and "change over all apparatus to which correct polarity is essential." As Mr. Groves truly remarks, this does "put too great a strain on my power of imagination." Mr. Groves has already found his faulty section, and his distributors consist of three single conductors—not concentric, which would alter the case for the worse. For some reason he is unable to drop on to the fault; therefore he changes the bad section over as already mentioned. Then he calls into every shop and house on the faulty section to see on which side each is connected. All the meters, arc lamps, Nernst lamps, and all apparatus to which correct polarity is essential on one side are then changed over! Next day, when the fault is put right, all this apparatus is changed back again! It will be seen that Mr. Groves treats his distributors very gently. I trust the consumers let him down as easily when he is changing over their apparatus!

The diagram below will also speak for itself.



V.C. is in this case the printer of the *Morning Star*, who has just been induced to throw out his gas engine. It will be seen that he is not likely to get a bad shock from his motor circuit, and that he will have enough light (on the ceiling) to swear by or at! Next day, however, the public will be "mourning t' *Star*" as they say in Lancashire.

A. J. Abraham.

Partick, *October 24th*, 1904.

Insurance and Consulting.

I have just noticed on p. 614 of your current issue a letter on the above subject signed "Consultant," and wish to strongly endorse his remarks. In fact, I have before me what appears to be even a worse case than he had in mind. The book to which I refer also advertises the Insurance Co.; but not only this, it devotes two pages to advertising their consulting engineering department, though the chief engineer to the firm is a full member of the Institutions of Civil and Mechanical Engineers. In other departments of the profession—namely, that of sanitary engineering—we have at least two, and possibly three, equally bad cases where one or more members or associate members of the leading institutions band themselves together under a trade name, and advertise in much the same manner as any trade or manufacturing firm, though, no doubt, they would claim to be, and are acting to all intents and purposes as, consultants. It is certainly highly desirable that some action should be taken, but apparently none of the institutions in any way fathers the profession in the manner that the medical or legal societies do theirs; consequently, our status in such matters is vastly inferior.

Second Consultant.

["Inquirer" asks: "Can you tell me the name and address of the suppliers of "Griffin insulation?"

["Exporter" asks: "Who are the makers of electrical percussion rock drills? 100 of such are required for direct current, and we know of no maker."—EDS. E.R.]

BUSINESS NOTES.

Condensing Plant.—Messrs. Isaac Storey & Sons, Ltd., of Cornbrook, Manchester, have secured the following contracts:—From the Admiralty for Priddy's Hard, Royal Clarence Victualling Yard, through Messrs. Mather & Platt, Ltd., for three sets of condensing plant; from the Admiralty for Sheerness Dockyard, through the Lancashire Dynamo and Motor Co. for three sets of condensing plant; from the Spanish Military Marine Ministry for Ferrol Arsenal, one set of condensing plant.

Change of Name.—With the consent of the Board of Trade, the name of the Angus Electric Light and Power Co., Ltd., has been changed to "The North of Scotland Electric Light and Power Co., Ltd.," owing to the extension of their undertakings.

Electrical Wares Exported.

Week ending October 20th, 1903.

Adelaide	Value £39
Alexandria	161
„ Teleg. mat.	168
Amsterdam	70
Calcutta	588
Cape Town	1,181
Chinde	35
Delagoa Bay	220
„ Teleg. mat.	1,687
Durban	923
„ Teleg. mat.	396
Gibraltar	136
Gisborne	24
Hong Kong	27
Kobe. Cable	990
Lisbon	17
Madras	147
Melbourne	140
Otago	119
„ Elec. engines	1,852
Penang	335
Perth	154
Rotterdam	21
„ Teleg. wire	45
Shanghai	2,332
Singapore	436
Stockholm. Teleg. wire	160
Sydney	1,919
„ Teleg. mat.	1,110
Tientsin	284
Trinidad	18
Wellington	1,200
Total	£16,473

Week ending October 18th, 1904.

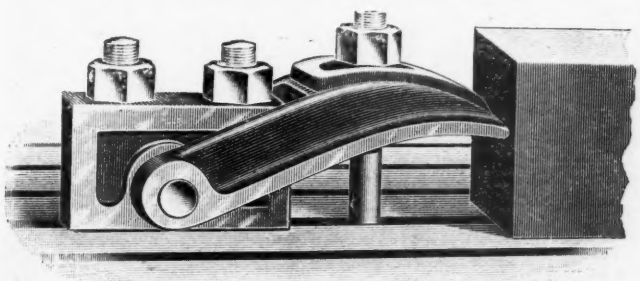
Adelaide	Value 15
Amsterdam	40
Antwerp. Elec. fuses	558
Auckland	57
Beira	31
„ Teleg. apparatus	238
Bombay	220
„ Elec. cable	3,856
Brisbane	35
Buenos Ayres	93
Cadiz	10
Calcutta	230
„ Elec. machinery	210
Cape Town	60
„ Elec. machinery	1,193
„ Teleg. mat.	2,207
Colombo. Elec. machinery	144
Constantinople	50
Cyprus. Teleg. mat.	15
Durban	1,412
„ Teleg. mat.	1,918
East London	49
„ Elec. machinery	98
Fremantle	20
Gibraltar. Teleg. mat.	40
Gothenburg	27
Halifax. Teleg. cable	36,329
Hamburg	102
Hong Kong	392
„ Elec. machinery	43
Lyttelton	20
Madras	129
„ Elec. machinery	83
Malaga	20
Melbourne	51
Mombasa	23
„ Teleg. mat.	250
Ostend. Teleg. wire 141 cwt.	
Paris. Teleg. mat.	3,240
Penang	58
Pernambuco	31
Port Elizabeth	481
Rio Janeiro	52
„ Teleg. mat.	16
St. Petersburg. Teleg. paper	295
Shanghai	108
Singapore	127
„ Teleg. mat.	23
Sydney	230
„ Teleg. mat.	158
Toronto	90
Wellington	94
Total	£55,271

Foreign Goods Transhipped.

Gothenburg. Elec. apprts.	Value £26
Melbourne. Telephones	900
Sydney. Elec. mat.	50
Total	£976

Port Elizabeth. T'l'ph'nes. Value £226

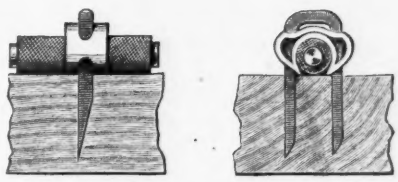
"Combination" Cramp. — This novel cramp was recently patented by Mr. A. E. Ingham, of Altrincham, and is now being supplied by Messrs. Ed. G. Herbert, Ltd., of Rosamond Street East, Manchester, the licensees and sole makers. The cramp consists of a strong steel arm, hardened on the wearing surfaces and pivoted on a cast-iron block (see illustration). The cast-iron block is firmly secured to the bedplate by means of two bolts, and the pivoted arm resting either on the work or against one side (when used as an end cramp) is further secured by means of a third bolt. It is evident that this device simplifies the setting of work on machine beds, especially where it has been customary to use numerous sizes of packing blocks, &c.



"Combination" Cramp.

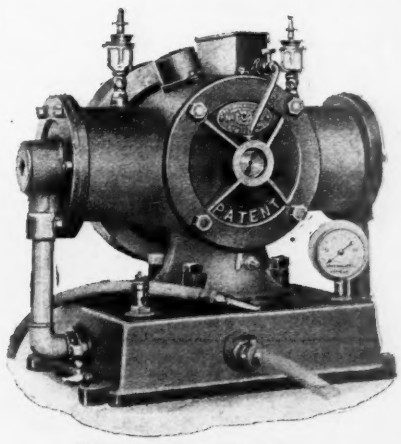
Cairns v. Reynolds.—In the City of London Court, on Friday, before his Honour Judge Rentoul, K.C., an action was brought by Mr. E. H. Hawkins, of 3, Barbican, as trustee under a deed of assignment for Cairns & Co., electric lamp manufacturers, 91, Queen Victoria Street, E.C., against Mr. Reynolds, of Hertford, to recover the sum of £3 10s. 9d. for electric lamps supplied. Mr. Cairns said he sold the goods to the defendant, the latter, however, said the lamps were supplied to him on a misrepresentation, and he wrote to Cairns and told them they did not answer the description. He requested Mr. Cairns to take them away and put up other lamps. Mr. Cairns had taken lamps which were worth one guinea a piece, and put up others which were only worth 9d. each. As a matter of fact, the lamps which were now in use were supplied by the electric lighting company who supplied him with energy. Mr. Cairns should look to the Electric Supply Co. for payment. Mr. Cairns said the Supply Co. would not pay him, and it was ridiculous to suggest that the lamps were not satisfactory, as there were hundreds of thousands of them working satisfactorily all over the country.—The Defendant: The lamps he is suing me for are lamps supplied by the Electric Supply Co., who agreed to supply me with electricity and lamps. The wiring was done free. Mr. Cairns said the matter could be tested, and that if the defendant had his electric current cut off the lamps in dispute would belong to him, and not to the defendant or the company. The second lamps put up were certainly worth 10s. each.—Judge Rentoul said he could not tell which of the parties were in the right, and he adjourned the case for further evidence.

"Blake" Insulated Staple.—A much improved type of insulated staple for telephone and bell wiring, &c., has been brought out by Messrs. Mosses & Mitchell, 68—71, Chiswell Street, E.C. The staple is square shouldered and sharp pointed, and the arch is thoroughly protected by vulcanised fibre, in such a way that the fibre cannot possibly be accidentally detached from the staple. The figures annexed speak for themselves.



"Blake" Insulated Staple.

New Air Compressor.—We illustrate herewith a compact and efficient air compressor mounted on a receiver base. The machine is a "Boreas" patent compressor, of the belt-driven type, manufactured by Messrs. Lacy, Hulbert & Co., Ltd., of 25, Victoria Street, Westminster, and Beddington, Surrey, and is arranged for a working pressure of 25 lbs. per sq. in. One of the most noticeable features is its silent working, the air intake being inaudible, and the valves returning to their seats without the slightest shock. The design is considered to be one that will at once appeal to a practical engineer on account of the large allowance made in all the working parts to withstand wear, and consequent reduction of repair to a minimum. The lubrication also is neatly arranged and thoroughly effective, no oil is lost in throwing or wasted by overflowing and running over the base on to other parts of the machine. Spent oil is collected in the bottom of the oil chamber, and may be drained off at the leisure of the attendant. The air receiver base is fitted with pressure gauge, safety valve, blow-off cock, and a neat instantaneous coupling to which one end of the delivery hose is fastened. We understand that one of these machines is in operation at the Kensington and Knightsbridge Electric Lighting Co.'s works, where it is used to compress air for cleaning dynamos, &c., and is giving entire satisfaction. These air compressors are sometimes mounted on a base-plate forming the air receiver, and fitted with an electric motor for driving the compressor. The whole plant can also be mounted on wheels for moving from place to place in electric power stations or elsewhere.



New Air Compressor.

Steam Specialities.—Amongst recent contracts received by Messrs. Holden & Brooke, Ltd., of West Gorton, may be mentioned one for eight of Brooke's water separators, for the London County Council, each for 12-in. pipes, ordered through Messrs. Musgrave & Sons, of Bolton; one Brooke's oil separator for the Ilford Electricity Works, to deal with 27,000 lbs. of steam per hour with vacuum trap (per W. H. Allen, Son & Co). Further orders have also been received for water separators from Messrs. Musgrave and Sons, Ltd., Craven Bros., Dick, Kerr & Co., &c.; and for

Brooke's new steam trap from the electricity works at Southend, Middlesbrough and Cape Town, the North-Eastern Railway Co., Admiralty Dockyard, Simons Bay (per Aiton and Co.), Dick, Kerr and Co., &c.

Patent Locking Glow-lamp.—We recently inserted in our "Correspondence" columns an inquiry regarding means for locking glow lamps in their holders so that they cannot be removed therefrom by unauthorised persons. Such a device has been evolved by Messrs. Barlow & Young, of 8, London Street, E.C., and is illustrated herewith. It will be seen that the base of the lamp is fitted with threaded pins, bearing conical nuts; the pins are screwed right and left-handed, so that on clamping

Patent Locking Glow-lamp and Key.

them between the jaws of the master key, which are so shaped as to grip the nuts, they can readily be screwed up tightly, even inside a narrow shade. When so screwed up, the nuts cannot be slackened back with the fingers or with any ordinary appliance, but can easily be loosened with the key.

For Sale.—From a notice which appears among our advertisements to-day, it will be seen that offers are being invited for the goodwill, lease of premises, fixtures, stock-in-trade, machinery and plant of W. & E. Sumner & Clementson, Ltd.

Codd Arc Lamps.—We regret to find that in the notice of these arc lamps which appeared on page 669 of our last week's issue, the address of the Codd Arc Lamp Co. was incorrectly stated. The address is Standard Works, Dame Agnes Street, *Nottingham* (not Birmingham).

Electric Fire Pumps.—Messrs. Merryweather & Sons have just supplied an interesting pumping plant to Messrs. Robinson and Cleaver's new premises in Regent Street. It is of great importance that the pump should run noiselessly, and this object is attained by using a Merryweather "Hatfield" pump, which is direct coupled to an electric motor, and there is consequently no noise due to gearing; the pump having three barrels the flow of water is constant, and there is no fear of water hammer in the pipes. The motor is provided with two commutators, and the pump is run at half-speed with good efficiency for domestic supply, and in the event of fire can be run at full speed, when it will throw two powerful fire extinguishing jets.

Forthcoming Book.—Mr. Henry J. Glaisher, of Wigmore Street, London, will shortly publish "X Rays: Their Treatment in Cancer and other Diseases," by R. J. Cowen, L.R.C.S.I., L.R.C.P.I., &c.

"Sentinel" Air Compressors.—Messrs. Alley and Maclellan, Ltd., of Glasgow, have just received an order to supply two of their "Sentinel" patent compound intercooling air compressors for Messrs. Wm. Beardmore & Co.'s new shipyard at Dalmuir. These machines are of size No. 8 double, having a total capacity of 5,500 cb. ft. per minute at standard speed. They will be coupled direct, each to a 400-B.H.P. Oechelhaeuser gas engine, supplied by Messrs. D. Stewart & Co. (1902), Ltd., who hold the whole contract for these plants. The compressors will each supply air at 30 lbs. and 100 lbs. per sq. in., the return from the 100 lbs. service being led to the 30 lbs. reservoirs, and the air supply will be automatically controlled by Alley & Maclellan's governors at both these pressures. The compressors are of the firm's standard enclosed type, all bearings being lubricated under pressure. This, it is said, will probably be the largest gas engine-driven compressed air installation in the country. Repeat orders for "Sentinel" air compressors have recently been booked from:—Palmer's Shipbuilding and Iron Co., Ltd., Jarrow-on-Tyne, 3,000 cb. ft., steam and motor-driven; Swan, Hunter & Wigham Richardson, Ltd., Newcastle-on-Tyne, 2,100 cb. ft.; Messrs. Forgiers et Chantiers de la Mediterranée, Havre, 1,500 cb. ft.; and for H.M. Dockyards, 3,500 cb. ft. During the past two years 233 of these machines have been sold.

Stanger Electric Baths.—Last week we paid a visit to the installation of electric baths which has been put down at 54, York Terrace, Regent's Park, by Mr. J. Stanger, a German electrician, who has opened similar baths on the Continent and in America during the past few years. The fundamental principles upon which these baths depend, are the localised application of a direct current, and the use of tannic acid in solution in the water, which is maintained at a temperature of 90 to 105° F. The current is applied at pressures up to a maximum of 25 volts, and up to a strength of 3 or 4 amperes, according to requirements, by means of a series of carbon plate electrodes, which are supported along the opposite sides of the bath by means of slotted brackets, in such a way that they can readily be disconnected where not required, and disposed so as to localise the bulk of the current at any desired part of the body of the patient, or to lead the current in any particular direction through the body. As the specific resistance of the solution is very high, a large proportion of the current passes through the body—a fact which is easily tested by placing the hands in the water while current is passing, and moving them towards and away from the electrodes. A personal test of this nature convinced us of the possibility of localising the current, which could be strongly felt when the hands were near the electrodes. A small centrifugal circulating pump is provided, with which a current of water can be directed upon any part of the person; and an electrode contained within the flexible pipe used for this purpose, enables an electric current to be applied therewith. Suitable means are provided for regulating the current strength. The main purpose of this type of bath is to treat patients suffering from gout and rheumatism, in which complaints we are informed that great success has been attained. It is not within our province to discuss the therapeutic effects of the system; the great value of electric baths, however, for the diseases named, and many other affections, is well known to medical electricians. Besides the baths above described, a special type which may be called an "arm-chair bath" is provided for diseases which cannot conveniently be dealt with in the larger baths, together with suitable accessories. Great importance is attached by the inventor to the use of tannin compounds in the water; and it may be added that no patients will be accepted for treatment without the express sanction and advice of their own qualified medical advisers.

Trade Announcements.—Messrs. Schiff & Co., carbon manufacturers, of Schwechat, near Vienna, have appointed Messrs. H. G. Mayer & Co., of 67, Aldersgate Street, E.C., as their agents for the United Kingdom. Messrs. Mayer will deal in arc lamp carbons, carbon brushes, battery carbons, &c.

Mr. F. M. Vincent has purchased the business of Mr. George Pyrke, electrical engineer, of 151, High Street, Bromley (Kent).

The London offices of the Key Engineering Co., Ltd., and of Cowans, Ltd., have been removed to 4, Queen Victoria Street, E.C.

The Stahlwerks-Verband Aktiengesellschaft, of Duesseldorf, have appointed the German Steelworks Union Agency, Ltd., 13-14, Abchurch Lane, London, E.C., as their sole agents for the United Kingdom.

Messrs. De Grelle, Houdret & Co., of 130, London Wall, E.C., announce that their agreement with Messrs. Schiff & Co., carbon manufacturers, of Vienna, for whom they have acted as sole agents for the last five years, terminates at the end of this month; they have, however, made arrangements to continue to supply their clients, as before, with first-class carbons. They also hold several other agencies, including incandescent lamps, insulators, copper wire, sheets and tubes, also flex, cotton and silk-covered insulated wires and cables, &c.

Messrs. Veritys, Ltd., have opened a sales depôt in Birmingham, at Carlton House, 28, High Street. This branch will be under the charge of Mr. N. Edwards, who has been representing Messrs. Veritys in the Midland district for some time, and was previously assistant manager at their works. Stocks of all material likely to be required by trade customers are kept, and letters from customers in the Midland district should be addressed there and *not* to the works at Aston.

The proprietor of the *Irish Engineering Review*, a sixpenny monthly journal which has been published in Dublin during the last six months, and has from the first been an interesting and creditable production, has formed the business into a limited company, with the title "The Irish Technical Press, Ltd." The last issue of the journal contains a prospectus and invitations to readers to subscribe for part of the £2,000 capital. The offices are at 18, Fleet Street, Dublin.

As announced in our last issue, under "New Companies Registered," the business of Muirhead & Co., of Elmer's End, Beckenham, and 12, Carteret Street, Westminster, has been, for family reasons, registered as a private limited company. There will be no change in the conduct of the business.

Electric Furnace.—We are informed that during the past fortnight Messrs. Marryat & Place have been demonstrating with an electric furnace at the Shoreditch Electrical Exhibition, and such unexpected interest have the visitors taken in the experiments, that the County Council ordered special railings to be erected, and upon most nights the police were requisitioned to control the crowd. Altogether about 11,000 persons looked through the coloured glasses into the furnace. The experiments consisted of fusing quartz and refractory metals, such as iridium and chromium, but the public expressed the greatest satisfaction with pots of boiling steel or molten fire-brick.

Browett, Lindley Engine Contracts. — Messrs. Browett, Lindley & Co., Ltd., of Patricroft, have, within the last few weeks, received the following orders:—

From Messrs. Mather & Platt, Ltd., three 200-kw. engines and one 100-kw. engine for the Priddy's Hard Victualling Yard and Royal Forton Barracks to Admiralty specifications.

From Messrs. Bruce Peebles & Co., for Canada, two engines, each to drive a 250-kw. alternator, these engines also to give a further 50 per cent. overload.

From the British Westinghouse Electric and Manufacturing Co., for the Froddingham Iron and Steel Co., one 375-b.h.p. engine. This engine to be capable of giving 100 per cent. overload.

From the Cellulose Fabrik Skotselven, Norway, one 40-b.h.p. engine.

From Messrs. Steel Bros. & Co., London, for delivery to Rangoon, one 50-b.h.p. engine.

From the Union Card Paper Co., Montreal, Canada, one 50-kw. engine.

From Messrs. Campbell & Isherwood, Bootle, two 30-b.h.p. engines for ship lighting.

The above orders total up to about 3,500 b.h.p.

Dissolutions and Liquidations.—Messrs. Walker and Hodgetts, Ltd., electrical manufacturers, Manchester, are winding up voluntarily with Mr. E. A. Radford, 86, King Street, Manchester, as liquidator. Creditors should send particulars to Mr. Radford by November 30th.

A meeting of the Metropolitan District Electric Traction Co., Ltd., is to be held at Hamilton House, Victoria Embankment, on November 28th to hear an account of the winding up from Mr. W. E. Mandelick, the liquidator.

Messrs. J. E. Wedekind and T. Miller (Charles Peacock & Co., electricians and engineers, 43, Clerkenwell Road, E.C.), have dissolved partnership. Mr. Miller will attend to debts, &c., and will carry on business as T. Miller & Co., at 66, Victoria Street, S.W.

A receiver has been appointed on behalf of the debenture holders in the Sir Hiram Maxim Electrical and Engineering Co., Ltd., of Gillingham Street, S.W. A circular issued by the secretary suggests that a scheme for reconstruction may be formulated at an early date, under which the business can be resumed. In the meanwhile, the business is being carried on by Mr. Alfred Hardie, the managing director, as receiver.

The Edison-Gower-Bell Telephone Co., of Europe, is winding up voluntarily.

The scheme for re-arrangement of Ferranti, Ltd., already outlined in our columns, was before the Courts in London on Tuesday, and was sanctioned with certain modifications.

Catalogues and Lists. — The British Thomson-Houston Co., Ltd., is circulating an attractive large-sized postcard for bringing the B.T.H. Edison electric lamps before the private householder. The picture represents Jones holding his electric light bill out under the light of a B.T.H. lamp, and you can hear him laughing and chuckling because it is so low; Mrs J. is looking over his shoulder also at the bill, but if one may judge from her serious mien she hardly joins in her husband's pleasure.

Circular B. 1,071 (revised), issued by the British Westinghouse Co. gives full details and illustrations of the Westinghouse "S.B." type direct current motors.

The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown, has in circulation just now several new price lists particularising the Rymer-Jones universal shunt, testing keys, and patent connectors.

The New System Private Telephone Co., Ltd., of 37, King William Street, E.C., is supplying a cheap line of private intercommunication telephones, and lists relating to same are at present in circulation.

Among a batch of new illustrated lists received from Messrs. Ferranti, Ltd., of Hollinwood, is one describing their class B current transformers for ammeters, power factor indicators, relays, and indicating wattmeters, for voltages from 100 to 5,000.

There came to hand, too late for mention in last week's "Special Fittings Number" of the Electrical Review, a very fine supplementary catalogue of new designs of artistic fittings for electric lighting, which are being made by Messrs. C. J. Thursfield and Co., of Birmingham. We showed two of their neat designs last week, and they may be taken as representative of the class of work turned out by the firm, but those who are directly interested in this sort of thing will find some very fine specimens of brackets, electroliers, lanterns, pendants, standards, and ceiling fittings in this new collection of illustrations.

Messrs. Johnson & Phillips have issued an illustrated list particularising fully their J. & P. motor starters, which were briefly described in our last issue. Prices and dimensions are tabulated of standard sizes from ¼ to 50 b.h.p.

The Lahmeyer Electrical Co., Ltd., in its No. 27 list just to hand, describes the type D.S.G. single-phase alternating current motors for heavy starting torque.

Mr. Arthur Koppel, of St. Clement's Lane, E.C., has sent us a copy of his latest illustrated list showing patent automatic water softeners. A full description of their principle, construction and advantages is given.

An October price sheet of "Protected" type direct current motors has been issued by the Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury Works, Bradford.

We have received from Messrs. Holden & Brooke, Ltd., a copy of their new List No. 69, describing Brooke's patent automatic boiler-feed regulator.

We have received from Messrs. R. Alger & Sons, lighting engineers, of Newport (Mon.) a copy of an illustrated souvenir prepared by them, giving an account of the workmen's annual outing to Teignmouth on September 3rd.

The Compagnie Generale de Constructions Electriques, of 63, Rue de Provence, Paris, send us their monthly bulletin of "Perles" gauze resistances, submerged resistances, "Thermique" arc lamp, &c.

The Electrical Co., Ltd., has just brought out several new sections of its price lists; "A" gives illustrations and particulars of continuous current dynamos and motors; "B" gives tabulated details of outputs, voltages, speeds and prices of the same machines; and "C" tabulates dimensions and gives drawings.

Full particulars of the Davidson patent steam pumps for boiler feeding, circulating, &c., are contained in a new illustrated pamphlet just issued by Messrs. W. H. Bailey & Co., Ltd., of Salford.

Belgium.—La Société d'Electricité du Pays de Liège is the title of a company which has just been formed in Liège, with a capital of £200,000, to establish, finance and carry on electric lighting and traction plants in the Liège district.

Book Notices.—*Machine Drawing.* By A. P. Hill. London: P. S. King & Son. 1904. Price 2s. 6d. net.—This is a volume for students at technical institutes, &c., especially evening classes, and contains 38 plates, giving a large variety of examples from actual drawings, fully dimensioned. The critical descriptions given with the drawings, as well as the practical rules and worked examples of calculations and test questions, cannot fail to be of great value to students, especially those who have to work largely by themselves. The nature of the subjects chosen is such as to familiarise the student with the machines and structures that he will meet with in engineering work, and the work appears to be well worthy of commendation.

"Mémorial de la Société Technique Impériale Russe." Parts 2—10, 1904. Edited by A. N. Sigounoff. Annual subscription (out of Russia) 16 r. St. Petersburg: Panteleimonskaiä, No. 2.

"Directory of Membership (No. 3) of the American Institute of Electrical Engineers."

"Directory of the Engineers' Club of Philadelphia, 1904."

"British Standard Specification and Sections of Bull-Headed Railway Rails." Report issued by the Engineering Standards Committee. London: Crosby Lockwood & Son. 10s. 6d. net.

"The Conductometer and Electrical Conductivity." By Rollo Appleyard. London: H. Alabaster, Gatehouse & Co. 1s. 6d.

"Handbook in Cable-Break Localisation: Graphic Methods and the Calculator Board in Practice." By E. Raymond-Barker. London: H. Alabaster, Gatehouse & Co. 1s. 6d. and 2s.

"Suonerie, Telefoni, Parafulmini, Descrizione degli apparecchi, guida pratica per la posa in opera." By Umberto Zeda. Milan: Biblioteca di Elettricità. L. 2.

"Medical Electricity—A Practical Handbook for Students and Practitioners." By H. Lewis Jones, M.A., &c. Fourth edition. London: H. K. Lewis. 12s. 6d. net.

"List of Members of the North-East Coast Institution of Engineers and Shipbuilders." Newcastle-on-Tyne: 4, St. Nicholas' Buildings, West.

"Annuaire Technique.—Accumulateurs Electriques (3rd edition); Combustibles (2nd edition); Carneaux et Cheminées (2nd edition); Chaudières a Vapeur (I. Théorie et Construction; II. Chaudières industrielles et accessoires (2nd edition)." By H. Rodier. Published annually. Paris: Rédaction, 64, Rue de la Victoire. London: Dulau et Cie, 37, Soho Square. Fr. 4.50 each.

Power Station Oils.—In view of the increasing adoption of the turbine system in electric generating stations, the Stern-Sonneborn Oil Co., of 57, Gracechurch Street, E.C., have given special attention to the question of a special lubricating oil, and have recently put on the market special qualities, which, we are informed, have proved themselves to be particularly well adapted for their purpose. The same company have also devoted special attention to cylinder oil for superheated steam cylinders, and their "Occentaline" 800 F oil is specially intended for this purpose. Particulars of this are given in a recently issued circular. The oil is claimed to have a very high flash point, also fire test, and retains its viscosity to an uncommon degree at the very highest temperatures to which it may be subjected. The Stern-Sonneborn Co. are already supplying regularly many of the largest electric generating stations.

Fire Alarm Demonstration. — The Leslie Walker Instantaneous Fire Detector and Fire Indicator Co., Ltd., held a demonstration of their system of fire alarms at the St. Peter's Institute, Buckingham Palace Road, S.W., on Tuesday afternoon, 25th inst.

St. Louis Exhibition.—Messrs. John Davis & Son (Derby), Ltd., have been awarded both a gold and a bronze medal for their special surveying and mining instruments shown at this exhibition.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—The T.C. has resolved that consumers of energy for power shall have the option of being charged on the maximum demand system at 2d. and 1d., or on a flat rate of 1½d. per unit.

Beaumaris.—The Council has resolved to rescind its resolution to apply for a prov. order in view of arrangements being made with the North Wales Power and Traction Co. for a supply of electricity for the town and neighbourhood.

Birkdale.—The District Electric Supply Co. has agreed to provide householders with wiring and fittings for six-light installations free of cost.

Bishop's Stortford.—The U.D.C. is applying for a prov. order. Notice appears in the *London Gazette* for October 25th

Brisbane.—With reference to the note which appeared on page 265 of our August 12th issue, under "Australasian News," we are informed that the statements given therein respecting the supply of electricity in North Brisbane are not quite accurate. The position of matters, from later information, is as follows:—The Brisbane Electric Supply Co., which is mentioned in the note as Burton & Co. (it should have been Barton & White), holds powers to supply over the whole of the city area, some 9·25 miles of streets. The Fortitude Valley Electric Light and Power Co. has only the Fortitude Valley area (containing about 2 miles of streets). The Brisbane Co. has laid cables in the principal streets, and runs a regular service. The plant, which is almost exclusively made up of Parsons turbine sets, had an output this year of 730,000 units.

Continental Notes.—An electricity works is to be established at Schonau, Germany.

A concession has been granted to erect a water-power plant on the River Serio, at Bergamo, Italy, for electric lighting and power purposes.

Application for permission to utilise the water power of the Seco River in the generation of electrical energy has been made, it being proposed to light the town of Muchamiel, Spain.

Datchet.—The electric lighting of the district was inaugurated on the 1st inst. by the Slough and Datchet Electric Supply Co.

Devonport.—The T.C. is negotiating with the Admiralty for supplying energy for lighting the Royal William Victualling Yard, the Royal Marine Barracks, and the Royal Naval Hospital.

Dublin.—Mr. P. C. Cowan, L.G.B. inspector, opened an inquiry in the City Hall on the 18th inst. into the application of the Corporation to borrow £21,000 in connection with the E.L. scheme. It was stated that it was necessary to provide additional plant in order to meet the increased demand for energy. A very lengthy discussion as regards the whole scheme for lighting the city took place at this inquiry, which was continued for three days, terminating on the 20th inst. Comparisons were made between the cost of the lighting of Dublin and the cost of the undertakings at Belfast and Cork.

The *Irish Times* taxes Mr. Robert Hammond with having saddled the citizens with a burden in the shape of a large capital expenditure on the E.L. scheme.

Earsdon.—The U.D.C. is inviting tenders for the public lighting of the district.

Gillingham (Kent).—The T.C. has received from the L.G.B. sanction to borrow £19,754 for E.L. purposes.

Glasgow.—The electrical engineer has been authorised to obtain and submit tenders for the supply of 800 demand indicators.

Godmanchester.—The T.C. has decided to invite offers for the use of the old water mills as a generating station for the production of electrical energy for public and private lighting.

Handsworth.—Good progress is being made with the new electric lighting scheme. Some 120 street arc lights, which it is proposed to put down, will absorb half the proposed capacity of the plant, the remaining half being for house and shop illumination. Energy for power supply, it is anticipated, will not be required on account of the residential nature of the district.

Inverness.—Work has now been commenced on the site of the electricity works to be erected by Messrs. Edmundson's Electricity Corporation.

Keighley.—The result of the past year's working, ended June 30th last, as shown in the electricity accounts just issued, is as follows:—

	1904.	1903.
Revenue, private lighting	£2,031	£1,414
,, public lighting	447	480
,, meter rents and sundries	445	208
Total	£2,923	£2,102
Total working costs, including public lighting ..	£2,091	£1,934
Interest	£1,306	£1,306
Sinking fund	£1,149	£1,089
Deficit for the year	£1,623	£2,227
Average price obtained per unit	3·8d.	3·66d.
Total working costs per unit	2·72d.	3·37d.
Number of units sold	184,307	187,721
Maximum load recorded	140 KW.	120 KW.
Total capital expended	£48,556	£47,596

Kuala Lumpur (Selangor).—The Director of Public Works reports that the electric lighting has been delayed by lack of labour, frequent changes in the executive staff and heavy mortality among the labour force employed at Ulu Gombak. It is considered that the arrangements for house lighting will probably not be finished until June, 1905. Up to the end of 1903 a sum of $277,000 was expended on this scheme, which is now estimated to cost $815,500. It seems that the electrical plant, supplied by the Maschinen Fabrik Oerlikon, had to be stored unopened for eight months on account of the delay. It is hoped that the packing was efficiently performed, for storage in a tropical country where an annual rainfall of 90 inches is below the average, does not seem very promising.

Uttoxeter.—The North Staffordshire Railway Co. has just put down a small lighting plant on its premises for lighting its station and yards. The current was switched on recently, and at present there are erected 18 arc and 40 incandescent lamps. The plant includes a direct-coupled generating set of 20 KW.

Launceston (Tasmania).—We give below a brief abstract of the accounts of the Corporation electricity undertaking for the year ended December 31st last, in comparison with the results obtained in the previous year:—

	1903.	1902.
Revenue, from lighting rate	£2,104	£2,121
,, private supply	7,545	8,045
,, meter rents and sundries	1,043	1,014
Total ..	£10,692	£11,180
Total working costs	£5,116	£4,543
Interest	£3,781	£3,718
Sinking fund	£1,143	£1,046
Profit balance	£652	£1,873
Average price obtained per unit	3·63d.	3·87d.
Total working cost per unit	1·73d.	1·57d.
Total number of units sold	707,317	692,312
Maximum load recorded	575 KW.	543 KW.
Total capital expenditure	£115,580	£111,866

Motors totalling 190 H.P. are now connected up, and when the new plant comes into operation, a large increase in power load is expected. Reductions in the price of energy, rents of meters and larger rebate, together with other items, account for the decrease in revenue during last year. The total placed to sinking fund amounted to £8,066, and to depreciation £1,000. New three-phase generating plant has been recently installed in place of the old alternators; there are four new machines of a total capacity of about 1,200 KW. Four of the old arc lighting turbines are to drive the exciters for the new sets. The works have been enlarged to accommodate a new switchboard of modern type. Two sets of feeders are to be run to a new sub-station in the city, containing two switchboards for distributing purposes. One controls four H.T. circuits to the town, and a line to three transformers of 120 KW. each, and the other board controls the L.T. supply. Underground four-core cables will convey L.T. three-phase current to supply the heavy lighting section, and a sixth H.T. circuit will lead to four rotary transformers, also installed in the sub-station for the enclosed arc lighting. A small controlling switchboard for the eight arc lighting circuits only, has also been installed here. The cost of completing the new system, together with a summary for the next five years' expenditure is estimated by Mr. W. Corin, the city electrical engineer, at £34,000, and it has been recommended that authority should be obtained to borrow such sums as may be required during that period up to £30,000. The expenditure up to March 31st last, including sums paid on the new plant, &c., stood at £127,000.

Leeds.—The Lighting Committee has recommended the Corporation to extend the electricity supply to Kirkstall.

Liverpool.—A statement recently presented to the Electric Lighting and Power Committee of the City Council shows that the number of consumers has increased during the past year from 4,790 to 5,345. The amount of energy supplied for lighting and power has increased 20 per cent. over 1903, and there has been an increase of 12½ per cent. in the electrical energy supplied for tramways, the total increased output amounting to 15 per cent. The new power station in Lister Drive will be in operation in the course of a few weeks, and additional plant is being provided for sub-stations. Another five miles of streets have been electrically lighted.

A L.G.B. inquiry was held on the 20th inst. in regard to the application by the City Council to borrow £400,000 for electricity supply purposes, this being necessary in order to extend the works and plant of the undertaking. There was no opposition, but a letter was received by the inspector protesting against any contributions being made from the undertaking to the general rate until the reserve and renewal funds stood at a higher figure than at present.

The assistant town clerk stated that the last loan which the Corporation obtained was in 1901, the sum being £300,000. The Corporation purchased the undertaking in 1896, when the output of electrical energy was 1,350,000 units. In 1901, the date of the last sanction, it was 20,000,000 units, while to-day it had increased to over 26,000,000 units.

London.—MARYLEBONE.—The B.C. has received its £1,415,000 loan from the L.C.C., and the temporary loans running since July 1st, have now been discharged. Agreements have been come to by the Electric Supply Committee for the acquisition of the sites required for the undertaking. The trustees of the Emanuel Schools are to receive £5,300; Messrs. Spencer, Turner & Co., for their interest in the Poplars, £2,100; and the leasehold of six cottages in Victoria Place, are to be purchased, with vacant possession, for £1,000.

HAMMERSMITH.—A statement as to the sanctioned extensions to the electric lighting plant was submitted to the B.C. recently. The sum voted was £40,000, which it was proposed to spend as follows:—Three boilers, including brickwork, feed water heater, forced draught apparatus, economiser, pumps, piping, &c., £12,100 (total amount of contracts accepted to date, £4,899); two 1,500-KW. turbo-alternators, including condensers, &c., £20,000 (total amount of contracts accepted to date, £18,483); ash conveyor, tank, battery, chimney, flues, extension of condensing plant, buildings, &c., £5,900 (accepted to date, £2,067); clerk of works and sundries, £2,000. The estimated payments on account of the extensions to March 31st, 1905, amounted to £18,483. The statement was received and approved, and it was resolved to apply to the L.C.C. for a loan to cover the latter sum.

Macclesfield.—The Council, in reply to a communication from the Board of Trade as to whether it proposes to carry out works under its E.L. order, which has now elapsed, stated that it does not at "present" intend to proceed with the undertaking. The Council refuses to let a company come in and also to take steps to carry out its own prov. order.

Margam (Glamorgan).—A prov. order was obtained by the U.D.C. in 1898, and negotiations are now pending with the South Wales Electrical Power Distribution Co. for a supply of energy in bulk from the company's Neath generating station. With the exception of a clause empowering the power company to deal direct with collieries and other power consumers in the Margam area, the terms of the proposed agreement, as submitted by the company, meets with the Council's approval.

Mexborough.—Application is to be made to the L.G.B. for a further loan of £4,000 for E.L. purposes.

Morley.—The accounts of the Corporation electricity department for the year ended March last have been issued, and below we give the principal figures, as compared with the previous year's working of the undertaking:—

	1904.	1903.
Revenue, private lighting	£1,651	£1,365
,, public lighting	£346	£346
,, meter rents, &c.	£365	£230
Total ..	£2,362	£1,941
Total working costs, including public lighting ..	£1,531	£1,787
Interest	£1,005	£1,022
Sinking fund	£784	£735
Deficit on year's working	£958	£1,603
Total number of units sold	162,958	134,999
Maximum load recorded	174 KW.	120 KW.
Average price obtained per unit	3·47d.	3·45d.
Total working costs per unit	2·25d.	3·17d.
Total capital expended	£26,804	£25,312

Ormskirk.—The Board of Guardians on the 20th inst. resolved to apply to the L.G.B. for sanction to borrow £5,000, the Board having decided to generate its own electricity for power and lighting purposes.

Ravensthorpe.—Notice appears in the *London Gazette* of 21st inst., that the U.D.C. is applying for a prov. order.

Rhyl.—The U.D.C. has resolved to apply for a loan of £2,610 for E.L. works extensions.

Rutherglen.—The T.C. has decided to apply to the B. of T. for an E.L. prov. order for the burgh, and a clause is to be inserted empowering the Council, if it thinks proper, to transfer the order to the Glasgow Corporation.

The latter Corporation recently discussed the terms of supply to the district, and approved of same. Consumers are to be placed on the same footing in regard to electricity supply as those in the city.

Salford.—The accounts of the electricity department for the year ending March 31st, have just been issued, and show total receipts for energy, rent of meters, &c., £67,288, out of a total revenue of £68,768. The expenditure amounted to £25,907, leaving a balance to credit of profit and loss account of £42,861. The generation of electricity cost £15,141. After liquidating a deficiency of £3,294 on last year's account, and paying £31,086 in interest, redemption of loans, &c., the Committee were able to place £8,000 of the year's profit to the credit of a depreciation and renewals fund; the balance, amounting to £1,380 being devoted to relief of the borough rates. The expenditure on capital account amounted to £48,233 12s. 10d. When it is remembered that this undertaking had previously shown losses on each year since its commencement, amounting in the aggregate to £33,446, the above-mentioned results for the past year are very satisfactory. Reductions have been made in the charges for energy, both for power and lighting.

Sheffield.—Mr. J. Bolton, of Darnall, is bringing an action against the Sheffield Corporation, claiming for damages done to goods in the market by the grit from the electricity works chimneys. The hearing has been postponed until November 24th.

Shildon.—The U.D.C. has sealed an agreement with the Northern Counties Electricity Supply Co., Ltd., whereby the latter undertakes to provide a supply of energy by January 1st, 1905.

Southport.—A L.G.B. inquiry was held on 20th inst. into the application of the T.C. to borrow £20,000 for electrical purposes. The estimate included £1,584 for 4 miles of H.T. cable; £6,000 for services and meters; £6,000 for L.T. mains; £1,300 for a new battery. The period for repayment of this loan is to be 25 years. There was no opposition.

Sunderland.—On the 18th inst. a L.G.B. inquiry was held into the application of the T.C. for leave to borrow £25,000 for purposes of extensions to the buildings and machinery at Hylton Road and Dunning Street stations, and extensions in connection with the sub-stations.

Stratford-on-Avon.—The T.C. has resolved to enter into negotiations with the Birmingham Installation Co. with a view to an arrangement with it, subject to B. of T. sanction, for the transference of its prov. order. The company proposes to build a generating station in Rother Street, and the plant to be installed is to include a storage battery to be utilised in conjunction with plant which it is also proposed to install at the Alderston Mills. At the latter place it is proposed to put down water turbo-generators as a subsidiary source of power supply.

Watford.—The Council has assented to its electrical engineer entering into contracts for the building of three sub-stations and laying of mains for the lighting of parts of the Harwood, Vi-Cocoa, and Crook Log Estates.

A tender of £3,745 was accepted recently by the U.D.C. for additions to the electricity works.

Winsford.—The B. of T. has revoked the 1899 electric lighting order.

Woolwich.—The Council has approved the laying of H.T. mains from Shooter's Hill sub-station to a main sub-station adjacent to the High Street at Eltham, and the necessary equipment. A sub-station is also to be provided at Lee Green, and the total estimated cost of the scheme is £14,729.

The poll of the ratepayers of Eltham has resulted in a large majority against the B.C. scheme for lighting the district by electricity.

Yarmouth.—The Port and Harbour Commission has given its assent to the borough surveyor's plans for laying a cable across the bed of the river to supply Gorleston with electric light.

TRAMWAY AND RAILWAY NOTES.

Belfast.—A meeting of the Finance Committee was held on the 17th inst., in connection with the purchase of the tramway system. The meeting was private, and it is understood that the means to raise the necessary £1,250,000 were discussed, and a deputation was appointed to confer with the London Corporation agents. It is stated that only £500,000 will be raised at first. The Tramways Committee subsequently decided to notify the National Telephone Co. to remove their overhead wires in the city, and to effect a similar arrangement with the G.P.O. A letter was read from the London County Council, giving permission to Mr. M. Arthur Young to act as valuer, subject to the Belfast Corporation taking a minimum of his time, and on condition that he should receive no fee.

Birmingham.—The report of the Tramways Committee, which comes up for approval at the meeting on 31st inst., contains the following estimated costs of the new tramway scheme:—

(a) Cost of constructing the new tramways, excluding electrical equipment	£295,580
(b) Cost of electrical equipment of new scheme; also reconstruction of electrical equipment of existing tramways, leases of which expire in 1906, which have not yet been reconstructed:—Track, electrical equipment and street works	235,000
Land, car-sheds, workshops and machinery	135,620
Rolling-stock	184,200
(c) Street widenings and purchase of properties	168,000
Total	£1,018,350

The report shows that, after excluding those who had no right to a vote, such as non-residents, lodgers, &c., there was really a majority of 22 in favour of the Harborne route; but the Committee, being anxious not to imperil the safety of the Bill by opposition from the wealthier landowners, as in 1901, has decided not to proceed with this part of the scheme. The Bill, which is at present being brought before Parliament, will mean the doubling of the tramway system in Birmingham.

Contracts have been entered into by the Corporation and the following firms for the new generating station and plant. In addition to the main generating station there will be three sub-stations, the order for the electrical equipment, including rotary converters, for these sub-stations having gone to the British Westinghouse Co., who have also secured the order for three 500-KW. and one 1,500-KW. three-phase alternators for the generating station. Messrs. Dick, Kerr & Co., besides securing the contract for the relaying of the permanent way of certain routes in conjunction with Messrs. Hadfield, also secure the order for three 1,500 KW. direct-current generators in the main generating station. All the foregoing generators will be direct coupled to engines of Messrs. Belliss and Morcom's make. There will be eight Babcock & Wilcox boilers installed, each capable of evaporating 24,000 lbs. of water per hour. Coal bunkers will be placed over the boilers, and mechanical stoking on the latest improved principles will be adopted. Messrs. Callenders have secured the underground cable contracts. Power for both the tramways and lighting will be supplied through the Electric Supply Department, and the distribution, as indicated, will be from sub-stations, one in Bordesley, one in Dudley Road, and one in Balsall Heath districts. The three-phase current used will be generated at 5,000 volts, 25 cycles, and the direct current at 500 volts. The building contract for the main station has gone to Messrs. Sapcote & Sons, Birmingham, and amounts to approximately £100,000. The contracts settled amount in all to about £300,000, and only refer to present extensions for electric lighting and tramway requirements for existing routes. If the Bill at present before Parliament for tramway extensions gets through, and there is no reason to doubt that it will, a considerable increase in plant will become necessary.

Brighton.—On Thursday, 20th inst., what might have been a serious accident happened to one of the cars. It appears that at 10.15 p.m., a car laden with 37 passengers started up Elm Grove, which is a continuous incline of 1 in 13 for three-quarters of a mile. When the car had gone up about 200 yards, all four wheels are believed to have become insulated from the rails by means of of sand and fallen leaves; what next happened is not made quite clear, but the current "went off" for the moment, and the car went running backwards with increasing velocity. The inside passengers, most of whom were women, were panic-stricken and crowded the back and front platforms, and six got off or were pushed off the car in the crush. Meanwhile the driver and conductor stuck

to their posts, and managed to partially get the brakes on in spite of the fact that their movements were hampered by the passengers. There is a curve at the bottom of the hill, but although the car had acquired considerable speed it managed to safely negotiate it, and was pulled up on the level without any damage being done. As it happens, the only persons injured are the six who got off the car whilst it was in motion. One passenger is suffering from concussion of the brain, but the remaining five were not seriously hurt.

Bury.—The Bury Tramways Committee having come to terms with Ramsbottom, has decided to seek powers, through Parliament, to construct tramways to Ramsbottom and Stubbins, from Elton Byway, Brandlesome Road and Holcombe within three years, at the end of which period the powers will revert to Ramsbottom.

Continental Notes.—France.—Line 3 of the Paris Metropolitan system has just been opened for a partial service. This line has a length of about 5 miles, and starts from Courcelles in the north-west, and runs to Père Lachaise, in the east of Paris. It divides the irregular ellipse formed by the lines 1 and 2. The car equipments for this line, 90 of which are being supplied by the French Thomson-Houston Co, include the well-known type M control, with automatic or hand acceleration at the will of the driver. There are six motors per train, each of 175 H.P., of French make. Five bogie cars per train are used, making a total length of 72 metres. There is seating space for about 400 passengers, and a further 200 can find standing accommodation. The first, third and fifth cars are motor-cars. All the train control apparatus is mounted in the motorman's cab, and the cabling is, where possible, bare. The coaches are 14·5 metres long. On Line 2 (north) there have recently been placed in service about 60 bogie cars with a length of 13 metres each, having a seating capacity of 74 passengers, and standing room for 45 more. The French Westinghouse Co. have supplied their latest type of pneumatic control for these trains. On Line 1, owing to the fact that the tunnels were not provided for coaches other than the small two-axle cars now in service, no bogie-cars are running. It is believed that a modified form of shorter bogie car will be eventually provided for this line. There are in active preparation two bridges over the Seine, destined to unite the Line 2 (south) with Line 2 (north), only the latter of which is in service. The bridges will be ready early in 1905, and Line 2 (south) is already practically completed. It consists of overhead work for the greater part of its length.

Italy.—Propositions have recently been laid before the Italian Government regarding a new and shorter route through the Alps between Turin and the Central European cities, *vid* Martigny. This will add a fourth route to the already existing Mont Cenis, St. Gothard and the nearly complete Simplon routes, and it is interesting to note that the distance to be covered between Turin and Paris will thereby be shortened by 50 kilometres, Turin—Bâle by 62 kilometres, Genoa—Lausanne by 75 kilometres, Turin—Lausanne by 143 kilometres, Savonne—Lausanne by 79 kilometres, and Nice—Genoa—Lausanne by 240 kilometres. This project, if realised, will be sure to ameliorate in a very sensible fashion the existing relations between northern Italy and the principal European centres, and it is believed that the Indian mail to Brindisi from London will be sent by this route in preference to all others. The length of the proposed line is 157 kilometres, and the maximum grades are 5 per cent. The line will be situated entirely among mountain ranges, and electric power for traction will be provided by utilising the numerous waterfalls in the region. Starting from the main line which unites Modane, on the French frontier, to Turin, the new line would cross the Canavais Plains to Pont, where it would enter the valley of Rouco, and, by means of a gallery hollowed under the well-known Grand Paradis range, it will touch the village of Cogne, thence, mounting the left side of the Aosta valley, it will pass Morgex, St. Didier and Courmayeur. From this place, by a tunnel through the Col Ferret, the line continues in Swiss territory to Martigny. The project is associated with the name of Radcliff Ward, who has given serious attention to the scheme. The Piedmont district is strongly in favour of the scheme, and a financial syndicate has been formed to support the project, now before the Italian Government.

Dewsbury.—The Dewsbury and Ossett Corporations and the Soothill Nether District Council having obtained powers to construct electric tramways within their respective areas, it has been decided to approach the B.E.T. Co. and the Wakefield and District Light Railway Co. with a view to negotiations for a lease. The lines will run from Dewsbury Market Place to Ossett Market Place *vid* Soothill Nether, and it is proposed to work them as one system.

Huddersfield.—The Tramways Committee has decided that a thorough medical examination shall be made of every employé when engaged, and afterwards an annual examination of the heart, and of the senses of smell, hearing and sight. One hour's pay is to be allowed each man for the time occupied in the examination.

A statement prepared by the borough treasurer for the past six months shows that the cars have run 864,306 miles, as against 834,160 during the corresponding period of last year. The receipts amount to £37,371 2s. 11d., or 10·38d. per car-mile, compared with 9·97d. last year. The expenditure was £19,199 8s. 7d., leaving a gross surplus of £18,171 14s. 4d. After applying £6,870 to interest, and £5,520 to redemption of loan, there is a net surplus of £5,781 14s. 4d. This statement does not include any provision for depreciation purposes.

The Tramways Committee has decided to seek an interview with the promoters of the scheme for connecting Halifax and Huddersfield by tramway, and, in the event of their agreeing to pay the costs incurred by the Corporation in obtaining powers to construct tramways to Brighouse and Rastrick, and satisfying the Corporation of their intention to construct the tramway within a reasonable time, that an agreement be entered into to transfer the Corporation's powers to the promoters subject to the approval of the Board of Trade and all other necessary authorities.

Leeds.—The last half-year's working of the Corporation tramways has resulted very satisfactorily. It appears from a statement of the accounts from March 26th to September 29th that the receipts amounted to £161,089, as against £151,367 for the corresponding period of 1903—an increase of £9,722. The increase is due, in part, to the more favourable weather this year, but partly also to the operation of what is locally called the "split turn" system. Working expenses were £83,500, as against £80,635 last year. The total for this year, however, includes a special sum of over £3,000 appropriated to maintenance of the permanent way. The balance of gross profit is therefore £77,585, as against £70,302 a year ago. From the sum of £77,585 there have to be deducted charges for depreciation, interest and sinking fund, and after these charges have been met there remains an estimated clear profit of £39,293, as against £36,890 last year. Considering the depression of trade which has existed, these figures afford material for congratulation. The running expenses (excluding the £3,000 referred to as spent on the permanent way) have been about the same as in 1903, although nearly 500,000 more miles have been run, and upwards of £10,000 more in receipts has been earned.

Liverpool.—In 1897 the total passengers carried during nine months by horse traction numbered 29 millions. During the nine months of the present year no less than 87½ millions have availed themselves of the use of the electric cars. The mileage has been doubled, and the revenue increased from £219,000 to £406,784. To the 101 miles of tramway are to be added 37 miles. The Tramways Committee has under consideration a scheme prepared by Mr. Bellamy for the carriage and delivery of light parcels and merchandise. As the scheme develops contemporary with its adoption on the great Manchester electric tramways system, and on other tramways in Lancashire, it will be possible by means of the connecting link formed by the Liverpool and St. Helens line to convey raw materials direct from the Liverpool Docks to the manufacturers in mid-Lancashire, and also to send manufactured articles by tramway to Liverpool. For this purpose special through trolley cars will be added to the service with running powers over the different systems. Offices will be opened in different parts of the city for the receipt and deposit of goods, and it is expected that the rates will be considerably lower than those charged for the delivery of parcels by the existing agencies.

London.—At the Court of Common Council on the 20th inst., a letter was read from the L.C.C. inviting the Corporation to agree to a proposal for connecting the present tramway termini in Blackfriars Road and Westminster Bridge Road by the construction of electrical tramways between those points *vid* Blackfriars Bridge, Victoria Embankment and Westminster Bridge. The L.C.C. proposed to ask for Parliamentary powers next Session to effect this connection, and requested the Corporation to assist them. The communication was referred to three committees.

Through a workman's pickaxe penetrating a cable near Brimsdown generating station on the 21st inst., there was a brief stoppage of the electric tramways connecting Finsbury Park, Tottenham and Wood Green.

Stoke Newington.—The B.C. last week decided unanimously that it be an instruction to the Council's delegates to the conference called by the L.C.C. with regard to the electrification of the North London tramways, not to offer any opposition to the adoption of the overhead system on the Moorgate Street to Manor House route, having regard to the material difficulties and expense in connection with the conduit system.

Newcastle-on-Tyne.—It is reported that a tramcar in going down a steep hill got beyond control, and leaving the rails dashed into the railway station buildings, which were greatly damaged. The front of the car was telescoped and the driver injured.

N.E. Railway Electrification.—That portion of the line of the North-Eastern Railway near Newcastle which has been electrically equipped by the British Thomson-Houston Co., Ltd., underwent a severe practical test recently. Owing to the festivities occasioned by the visit of the Channel Squadron to Newcastle, the passenger traffic on the electrified line was enormously increased, necessitating on the first day the continuous running of 86 out of the possible 89 available cars, and on the following day the full complement of cars (89) between the hours of 5 p.m. and 11 p.m. Although the equipment was subjected to exceedingly heavy and unusual demands, we are informed that not a single breakdown or interruption to service was experienced. The ability of the line to successfully meet sudden and heavy demands augurs well for the future of heavy electric traction.

Stockport.—The Corporation's offer of £24,000 for the Hazel Grove Tramway Co.'s undertaking has been accepted by the shareholders of the company, and the money will be paid over by the Corporation in December. In addition to the purchase money, the corporation will expend a further £60,000 in replacing the horse trams by an electric system. The system now purchased extends over four miles.

(*Continued on page* 711.)

THE LANCASHIRE DYNAMO AND MOTOR CO.'S WORKS AT TRAFFORD PARK.

Of recent years Trafford Park has taken a prominent position among the manufacturing localities of Great Britain; its development has coincided largely with that of the electrical business, and situated as it is on the borders of the Manchester Ship Canal, with shipping facilities to all quarters of the globe and railway connections to all the great trade centres of home industry, it is not surprising that several well-known electrical firms should have selected this neighbourhood as a very suitable one for the development of their respective businesses. The present article deals with the works of the Lancashire Dynamo and Motor Co., which, as will be seen from the general view in fig. 1, are situated in close proximity to the Ship Canal and cover an extensive area.

Fig. 1.—View of the Lancashire Dynamo and Motor Co.'s Works, Trafford Park, Manchester.

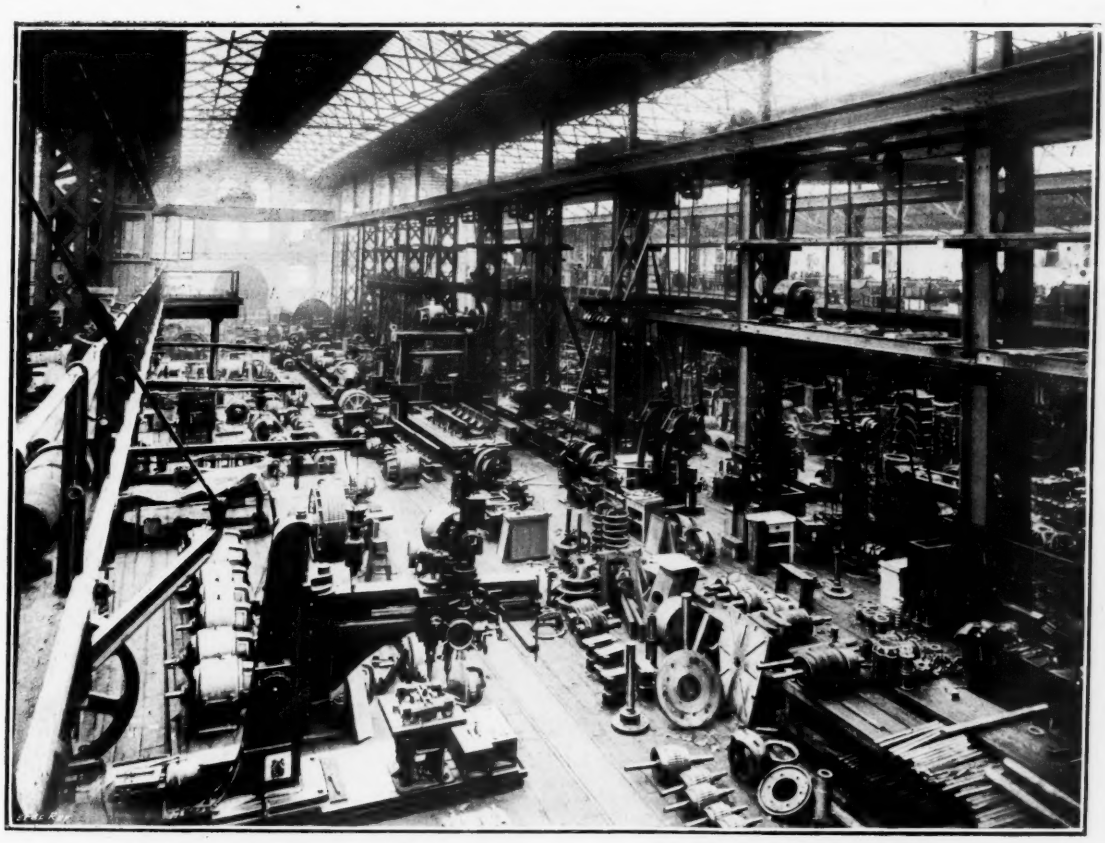


Fig. 2.—View across Large Machine Shops

Registered in April, 1899, the firm started in a small way in July, 1900, and successive extensions have led up to the present works which employ some 500 hands, and are shortly to be further added to.

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Fig. 3.—Shop for winding Field-magnet and Armature Coils.

The buildings comprise two large bays occupied by large machine tools and provided with galleries on either side; adjacent to this on one side are seven newer bays devoted to armature and commutator building, the erecting of finished machines, and storing of finished parts, &c., and on the other side are situated the offices, pattern shops, and brass foundry, dining rooms for the employés, a large packing, and what will eventually be a testing building, the present testing bed and plant, temporarily located in one of the big machine bays, being in process of removal.

It may be here mentioned that the whole of the works is electrically-driven and lighted, energy at pressures of 500 and 250 volts D.C. being obtained from the Trafford Park Power Co., and that a complete ventilation plant is installed on the Sturtevant plenum system, in which the air heated to the required temperature, is delivered through ducts at selected points throughout the works.

The two bays of the big machine shop, which we illustrate in figs. 2 and 7, are each equipped with three motor 10 and 20-ton travelling cranes, the motors in this case and elsewhere about the works being the firm's standard productions.

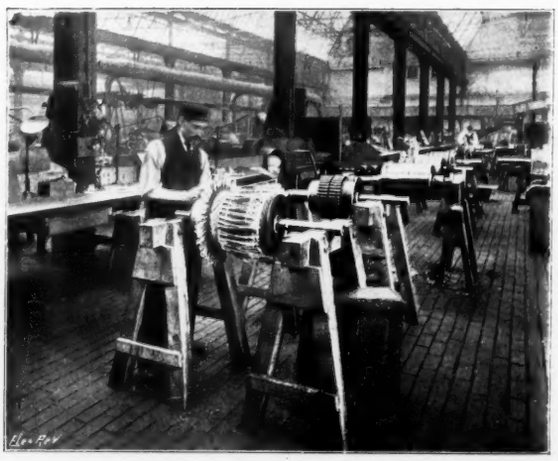


Fig. 4.—View in Armature Winding Shop.

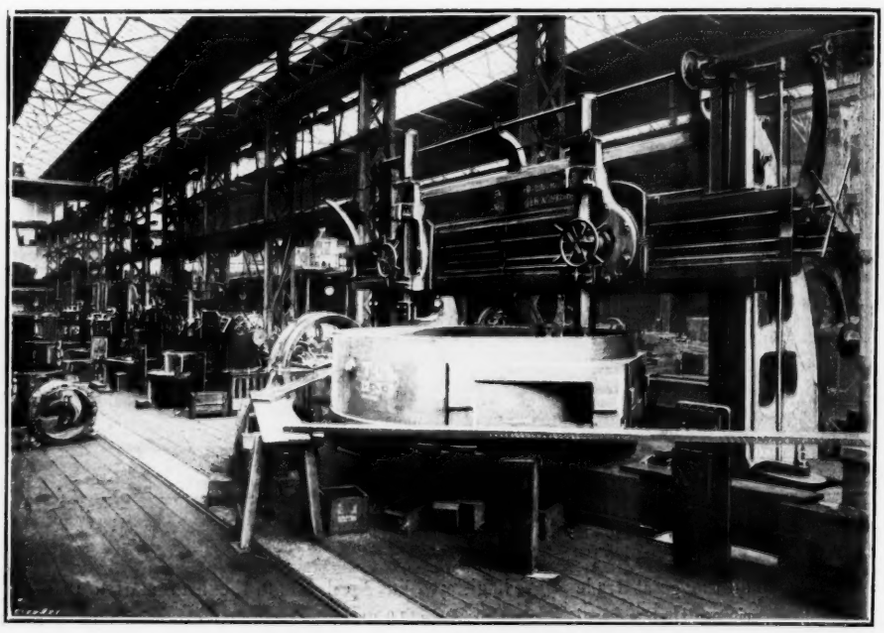


Fig. 5.—View of Horizontal Boring Machines in large Machine Shop.

Among the machines we noted a large horizontal boring mill, figs. 5 and 9, to take up to 18 ft. diameter several smaller machines of the same type constructed to deal with diameters up to 10 ft.; a large horizontal planing machine to take work up to 18 ft. × 6 ft. × 6 ft., and a heavy lathe to deal with diameters up to 8 ft. 6 in.

The numerous other tools in this shop consist principally of drilling and planing machines and lathes, and include large multiple drills fitted with six and eight spindles respectively, and used especially for drilling the halves of magnet yokes.

The work here dealt with, is principally the machining of the heavy castings for field-magnets and bedplates, and all the larger machine tools are independently motor-driven, the arrangement adopted being the company's own system of variable speed driving, by means of shunt regulation only, with which speed ratios of 3 to 1 and 4 to 1 may be obtained, and which they claim to be sufficient for all ordinary purposes, rendering the use of double commutator motors unnecessary. This type of motor and regulating equipment can be seen in figs. 8 and 9. The motors used vary in size from 1½-H.P. on the small to 5-H.P. on the medium size machines.

The large machines previously described are equipped with motors up to 20 H.P., which size is also used for driving, through line shafting, several groups of smaller machines. Our attention was directed to one of the latter, which is specially

designed for trueing up the slots in the armature cores, in place of the usual lengthy filing operation.

Turning to the seven bays which run at right angles to the large shops, the first one is devoted to armature building, with a section divided off as an armature stores; in the succeeding ones may be seen the operations of commutator building and pressing, former winding and taping of field coils, the fitting-up of brush gear, the soldering of the armature end connections, a single operation in which the end of the armature bars with the end connections clipped on to them, are dipped into a ring of molten solder; and erection of complete machines; the storage of completed parts also occupies a considerable area, and in one bay are situated a number of capstan lathes on which all the machining of the various dynamo and motor parts, with the exception of magnet work, is carried out.

Fig. 6.—View in Erecting Shop.

In this section of the works, also, is situated a vacuum dryer for drying out armatures and field coils, and each of the bays is equipped with a three-motor, five-ton electric traveller, the speed and adaptability of which form such a marked feature of modern engineering shops.

At one side of the large bay is situated the tool room, than which no department in recent years has undergone more transformation.

This tool room is equipped with a selection of small machinery, emery grinders for tool manufacture and repair, while complete tool outfits, together with the necessary jigs and templates, for any particular operation undertaken in the works are stored here, labelled according to the size of the dynamo or motor, the parts of which are to be worked on.

These special tools are only issued to a workman in exchange for a check bearing his number, the check being hung up against the space previously occupied by the tool which is given out. This procedure is representative of the modern tool-room system by which the care and regulation of the tool is taken out of the workman's hands; in fact, is placed in the hands of specialists.

In the tool room are also stored the numerous drawings used about the works; these are mounted on boards and filed in a vertical position; on the outside edge of the board is the name and number of the drawing for purpose of identification.

Fig. 7.—View of large Machine Shop, also showing Completed Dynamos and Motors ready for Testing.

It will be seen that this small department practically holds the key to the efficient manipulation of the work in the various departments, and its importance is difficult to overestimate.

Continuing our survey of the departments, we find on the opposite side of the big machine shops, already dealt with, the pattern shop and stores, in connection with which it should be mentioned that standard patterns of dynamos and motors from 1 to 1,000 KW. are in stock.

Adjacent to the pattern shop is a smithy and a brass foundry, the former equipped with the usual forges and a power hammer by Masseys; and the latter, a department which economically uses up the very considerable

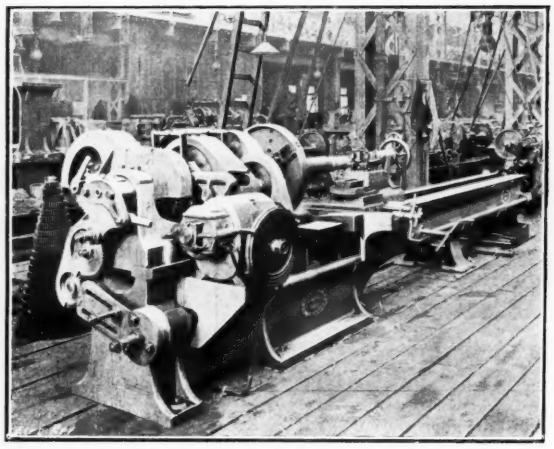


Fig. 8.—View of Lathe fitted with Variable Speed Drive (Shunt Regulation only).

amount of scrap brass and copper from the other sections of the works.

Beneath the pattern shop is situated an extensive mess-

Separated from the other portions of the works on this side, is situated a building used as a rough castings store

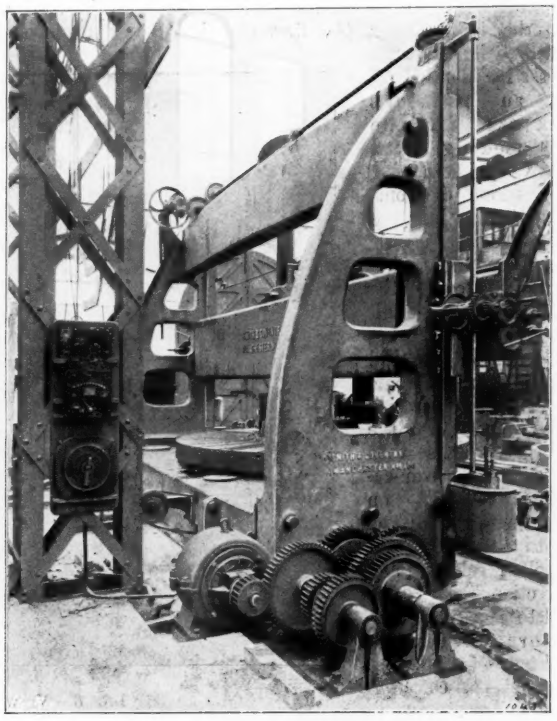


Fig. 9.—View of Variable Speed Motor Drive to 18ft. Horizontal Boring Machine.

and packing shed; this, however, will shortly be removed into an extension about to be built, and the building thus vacated will form a roomy testing shed, where the firm's

Fig. 10.—Reversing Booster, Turnbull & McLeod's Patents.

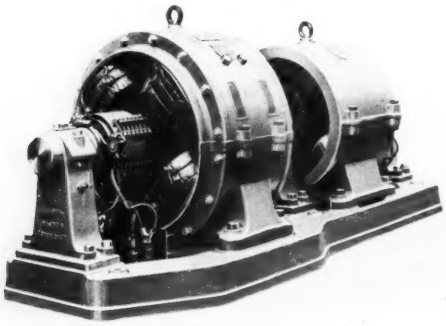
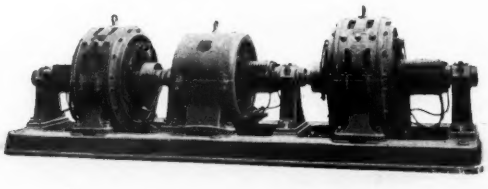


Fig. 11.—Reversing Booster for 3-wire System.



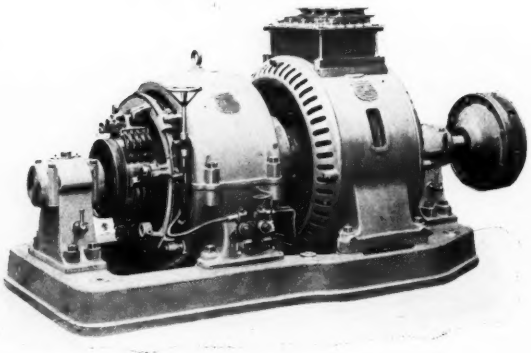


Fig. 12.—Crane Testing Set to give Alternating or Direct Currents.

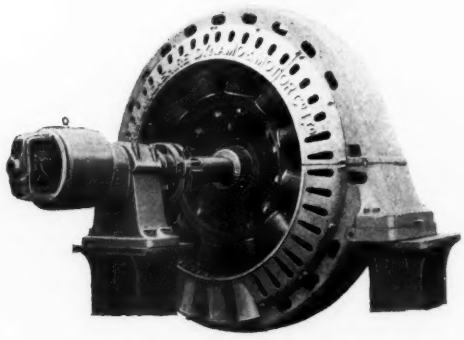


Fig. 13.—Standard Alternator and Direct-coupled Exciter.

room, capable of accommodating some 540 men, and provided with ample water-heating apparatus and gas stoves.

Needless to add, these buildings are of fireproof construction, and provided with means of isolation in case of need.

products can be finally certified as in order, before passing into the hands of the packer.

It may here be mentioned that the firm employs a system of labelling the various parts of the machines as they pass

through the several departments. Thus an armature, before leaving the armature department is tested, and if correct, is sent through to the next department with a green label attached, or if defective in any way, a similar red label is affixed, stating the defect, and it is returned to the armature department for adjustment. When the complete machine is assembled and tested it receives a blue label if satisfactory, and is passed on to the painting and packing department; however, before its despatch from the works, and when absolutely complete in every respect, the machine is again inspected by the testing department, and a final yellow label is put on, signifying that everything is in order, and that the machine can leave the works, and without this final certificate of character, no machine can be sent out.

In the office buildings are located the drawing and commercial offices, the former equipped with modern swivelling drawing boards, at which the draughtsman stands at his work; also with an electro-printing apparatus for producing the numerous prints supplied to the shops.

It is interesting to note that this firm has adopted the vertical filing system with card indexes for all its correspondence, technical data, &c.

Turning from these rapidly growing works, it is of interest to glance at the electrical products through which the firm has been able to build up such an excellent reputation. The company rigidly adheres to its standard designs, which comprise continuous and alternating (polyphase) current dynamos and motors and one or two special machines. Rapid and economical production is ensured by manufacturing in quantity; thus all sizes of D.C. motors or dynamos up to 50 H.P. are built in hundreds, above that H.P. and up to 100 H.P. in 25's, and above 100 H.P. in 5's.

Only two sizes of standard brush-gear are employed, the first size being fitted on all machines up to 50 H.P., and the second for all larger powers.

The field-coils of these machines are each provided with terminals, and so arranged that in case of dismantling for repairs it would be almost impossible to wrongly re-erect them. The machines are provided with swivel bearings, and the brush-holders have both "off" and "on" positions; while the main leads enter the casing of the machine through special bolt and nut terminals.

In the polyphase induction motors which the company supply largely for mining work, we noted a novelty for the purpose of giving increased safety in operation, in the shape of cased-in slip-rings, the casing being of aluminium and easily detachable; further, with a view to facilitating the running of the induction motor in inaccessible places, provision has been made by means of three taper studs, on either end bearing plate, for lifting the rotor slightly in cases where, through unavoidable continuous running, the bearings begin to wear and let the rotor on to the stator. This novel arrangement should not lack appreciation among the mining fraternity.

On the occasion of our visit to the works, numerous examples of both direct current and polyphase plant were in hand; we noted a 400-KW. compound wound multipolar generator for lighting and traction purposes under construction for the neighbouring U.D.C. of Stretford; two 10,000-volt, induction motor-generators; the generators being two-phase, 60 p., machines with 10,000 volts pressure on the stator windings and coupled to 275-KW. six-polar shunt-wound generators, generating at 550 volts pressure, these machines are to work in conjunction with the firm's special reversing booster, constructed under Turnbull & McLeod's patents, and are being constructed for the Acton U.D. Council's new electrical scheme.

This type of machine is illustrated in fig. 10, and consists of a shunt-wound motor coupled to a specially wound booster. The field windings on the latter are four in number, consisting of a shunt winding across the booster terminals, an auxiliary shunt winding connected across the bus-bars, a series coil between the negative dynamo terminal and the negative main, and a small series coil placed in series with the booster armature. The first shunt coil accomplishes the equalising of the battery and booster and bus-bar voltage; the second shunt coil would increase the booster voltage, but its effect is counterbalanced by the third or series coil when their magnetising effects are equal, *i.e.*, when the line current is normal. If the latter should increase through an overload, the series coil effect preponderates and the battery discharges; if the line current reduces, the contrary effect is produced by the shunt winding and the battery charges until a balance is effected.

The fourth series coil acts as a compensator for armature reaction and pressure drop on the booster.

Boosters of this type have been supplied to Bury, Stretford, West Ham, Great Western Railway Co., Swindon, &c., and a similar machine (fig. 11) adapted for working on the three-wire system, in conjunction with a battery, has been supplied to the North-Eastern Railway Co. at Darlington; in the latter case out-of-balance currents produced by some 70-ton cranes which are operating on the power circuits, have to be dealt with.

Another speciality of the firm which has met with considerable success is a crane-testing set (fig. 12).

This comprises a direct and an alternating current machine mounted in tandem and driven direct by a variable speed motor, through a flexible coupling.

The D.C. machine will give any D.C. voltage, boosting with or against the shop voltage, or it will give independently 220 to 500 volts; the alternator, by means of suitable plug connections, can be made to give 1, 2, or 3-phase current with periodicities of from 25 to 60, and any voltage.

At the time of our visit, a number of Leitner-Lucas patent train lighters were in course of construction—these little constant current combinations, each consisting of a main dynamo for supplying the lighting, and on the same shaft a small dynamo for controlling the field of the larger machine, at various speeds, being largly used by the railway companies.

Space prevents us from commenting further on the interesting work carried out by this establishment, and our brief survey of a rising British firm and the equally British methods employed with such successful results, must be concluded with an expression of our thanks to the enterprising manager, Mr. A. P. Wood, through whose courtesy we are enabled to prepare this description.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 706.)

Pontypridd. — After much negotiation, the dispute between the Pontypridd U.D.C. and the B.E.T. Co. as to the price to be paid by the Council for the old horse-tramway between Pontypridd and Hafod has been settled at £5,500, without recourse to arbitration. The Council's original offer was £2,842, and on this being refused, the Board of Trade was asked to appoint an arbitrator, nominating Sir Colin Scott Moncrieff. However, at the company's suggestion, negotiations were resumed before any steps in the arbitration proceedings were taken. At the Pontypridd Council meeting on the 4th inst., Councillor Bramwell, chairman of the Tramways Committee, announced that the company had now agreed to accept the sum of £5,500 offered by the Council three months ago, and a resolution sanctioning this settlement was passed. The relaying of the track for electric traction will be proceeded with at once, and the Rhondda Council is to be approached with a view to arranging a through service from Pontypridd to Porth, *vid* Hafod.

The electric tramways which the U.D.C. has been laying down about Pontypridd and Treforest are now fast nearing completion. A proposal that a report be obtained on the relative advantages of leasing and of working the lines has been dropped, as the Council intends to keep the tramways in its own hands.

Rosario (Argentina).—Intelligence from Rosario states that a powerful syndicate has a scheme in hand for the construction of an electric tramway to Alberdi *vid* Sanchales Station, the subway, and the sugar refinery district. The proposed lines would open up a thickly populated locality, at present cut off from the rest of the city.

Rowley.—The construction of the new tramway in this district from Old Hill to Blackheath has now been completed, and it will be opened for traffic during next month.

Salford.—The accounts of the Tramways Department, recently published, show a total income for the year ending March 31st, of £198,646 1s. 8d., and an expenditure on revenue account of £138,541 6s. 4d., leaving a gross profit on the year's working of £60,106 14s. 11d. The receipts in tram fares amounted to £198,622 7s. 6d.; a sum of £161 18s. 1d. was received from the Manchester Corporation, being the proportion of fares due to Salford for working the Bury Old Road lines; and £63 15s. 8d. was recovered for damage to cars, bringing the total income up to the figure above

stated. The cost of electric current was £47,986 10s. 2d., traffic expenses amounted to £57,508 17s. 1d. (including £40,494 for wages of drivers and others), and £2,185 was paid to the Manchester Corporation for hire of cars. The item of "general expenses," amounting to £15,448 14s. 9d., includes a sum of £4,490 5s. 10d. in respect of accidents, compensation accounting for £2,799 18s. 11d. Expenditure on repairs amounted to £17,597 14s. 4d., of which £9,519 12s. 3d. was for cars, £4,048 3s. 7d. permanent way, and £3,620 7s. overhead equipment. The total income on profit and loss account was £60,348 17s. 8d., and was disposed of as follows:—Interest and redemption of loans, £34,005 14s. 2d.; rents of lines, £10,903 4s. 5d.—Manchester Corporation, £6,355 12s. 7d., Eccles Corporation, £4,147 11s. 10d., and Prestwich District Council, £400; depreciation and renewals fund, £3,439 19s. 1d., the balance (£12,000) being transferred to the borough fund in aid of rates. The high price paid for electricity—2d. per unit, less 2½ per cent. discount—has seriously hampered the Tramways Committee during the past year. As a result of a vigorous protest, the Tramways Committee is now charged only 1½d. net, which will mean a difference of over £10,000 in favour of the Committee on the year's working, and will enable it to deal with the reserve and renewals fund in a more adequate manner than at present.

Wolverhampton.—The last of a series of Board of Trade inspections took place on Thursday last week, when Lieut.-Col. Yorke went over the Wednesfield Road extension, and, after a close examination, expressed himself thoroughly satisfied. He also gave permission to the Corporation to commence running the cars at once; but up to the time of writing the line has not been opened for traffic, presumably because there is a scarcity of cars, and there is something still to be done to the track. A movement is now on foot amongst the residents in the vicinity of the Newbridge section of the tram route to get the Corporation to re-open the length of line from Newbridge to Coleman Street, which was closed because it was said it did not pay. It is urged that by a re-arrangement of the fares, the line—which was the first portion of the system constructed—could be made remunerative, and its re-opening would certainly be a great public convenience.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephones.—The question of depreciation in regard to the Corporation system was again discussed at a meeting of the T.C. Mr. Russell, in terms of a notice of motion, moved that, in consequence of the divided opinion of the Corporation as regards the present and future value of the telephone undertaking, it be remitted to the Telephone Committee to call in the services of an expert in order to report to the Corporation as to the present state and value of the plant, and the probable depreciation that will require to be given effect to in order to avoid loss when the undertaking is sold to the Government at a fair value 10 years hence. He pointed out that for the year ending May, 1902, the sinking fund was only at the rate of 1 per cent.; in the next year it was 2$\frac{1}{16}$ per cent., and last year it was 2$\frac{5}{8}$ per cent. on the capital expenditure. The result was, that in their short career the telephone department had actually spent £320,782 12s., and this had been watered to the extent of £17,001 14s. 11d. for preliminary and general expenses. For the three years the sinking fund amounted to £16,110, and, in addition, they had created a general reserve fund of £5,743 7s. 5d. Taking the amount written off and the general reserve fund together, they got the sum of £21,853 7s. 5d. Deducting from that the £17,001 14s. 11d. preliminary and general expenses, there only remained a balance of £4,851 12s. 6d. He contended that the sum of £17,001 was originally created in order that it might be written off reserve during the first two or three years' existence of the concern, and that was not done because they could not show up the accounts in a proper way without making a loss. As to depreciation, he did not think anybody would say that it should be less than 7½ per cent. The only part of the plant to which a small depreciation of 5 per cent. could be applied was the underground portion of the cables, amounting to £168,000. Of the remainder, £47,428 was represented by overhead construction. With regard to the instrument account, he had thought that that represented the value of the instruments; but on inquiry he found that it included the cost of fitting up, and the greatest portion of the account was made up of wages and stores. The previous question was moved by Mr. W. F. Anderson, who said that it was only two months since they passed the accounts by an overwhelming majority. After a long discussion, the motion was negatived by a large majority.

Portsmouth Telephones.—At a meeting of the T.C. on Tuesday, the Telephone Committee submitted a report recommending that application be made to the L.G.B. for sanction to borrow £20,000 to cover future extensions of the telephone system, the estimate being 1,000 lines at £20 per line. This was exclusive of the extension to Southsea, and the money would only be spent as further extensions were found to be desirable, which extensions, before being carried out, would be submitted to the Council for approval. It was considered desirable that the application should be made to enable the extension to be made, if approved by the Council, without having to wait on each occasion for a separate sanction from the L.G.B. It was pointed out that this would be following the procedure which was adopted with regard to loans for electric lighting purposes.—Mr. Dittman, Chairman of the Committee, in moving the adoption of the report, said orders were coming in at an average rate of 10 a week, without any undue pressure or advertising, and it was anticipated that the loan to be asked for would be expended in two years.—The report was adopted.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	Oct. 10, 1904	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Paramaribo-Cayenne	July 13, 1904	
Bundaberg-Gomen (New Caledonia)	Aug. 30, 1904	Oct. 21
Cape Haitien-Mole St. Nicholas	Aug. 20, 1904	
Swakopmund-Mossamedes (under repair)	Oct. 10, 1904	
Bolama-Bissao	Oct. 13, 1904	
Nassau-Jupiter Inlet	Oct. 20, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto Bairros	July 28, 1902	
Seoul-Gensan	Feb. 18, 1904	
Seoul-Masampo	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Caimanera-Santiago	June 15, 1904	
Kertch-Soutehoum	Sept. 27, 1904	
via Bhamo beyond Tingyuch	Oct. 15, 1904	
Communication with Bagdad	Oct. 23, 1904	Oct. 26

Underground Telephone Wires in Manchester.—In consequence of the danger arising from telephone wires when strung overhead, across tramway routes, an arrangement was made with the Manchester Corporation some time ago, by the National Telephone Co., for laying the wires underground. The work is now making rapid progress. Routes are selected as far as possible from the main thoroughfares, in order that the inconvenience to business, arising from the opening of the streets, may be reduced. The work has, according to a report lately presented by the city surveyor, been completed under certain contracts, and taken over by the Telephone Co. in three cases, and cables are now being laid. In the other cases, the laying of the pipes is in progress, and will shortly be completed. The length of pipes is 107 miles 1,476 yards, and the cost of the work, under 10 contracts, is £37,413. The Corporation is now in receipt of an annual rental of £1,690 for telephone easements, based on the number of subscribers and the junction boxes in use, and the rent will be increased as the system is extended. When all the contracts are completed, the overhead telephone wires on tramway routes within the present city boundary can be placed underground. The cable laying is proceeding rapidly. The question of laying telephone pipes within the districts of Moss Side and Withington has been deferred, pending the inclusion of these districts within the city.

Wireless Telephony.—A new method of wireless telephony is being developed by Prof. Quirino Majorana, of Rome. This system, according to reports in the Italian technical Press, seems to be based essentially on the practice of wireless telegraphy. In the latter a series of impulses, corresponding to the sparks, is observed at the receiver, while a stream of sparks is made to pass at the transmitting station. The receiver used enables the operator to decipher the telegrams acoustically, listening to the series of sparks. The number of sparks, however, does not exceed 10 per second in the telegraph apparatus, whereas Majorana has increased this number up to 10,000 per second, though the various sparks are evidently weaker than those used in wireless telegraphy. Persons placed at the receiving station will therefore not notice anything, the succession of sparks being too rapid, and the sparks themselves too similar to one another. As soon, however, as the uniformity of these sparks is interrupted artificially by the oscillations of the human voice, every word will be transmitted truly to the receiver. The series of sparks has, therefore, to be modified under the influence of the human voice or of any other sound.

Prof. Majorana's endeavours resemble the scheme outlined by Prof. H. Th Simon and Dr. Reich. According to the researches of these experimenters, the problem of wireless telephony by means of Hertzian waves has been solved, at least theoretically. Wireless telephony requires continuous wave currents, and these were obtained by Prof. Simon by the aid of an Arons-Hewitt mercury lamp as a vacuum spark gap, when the discharge pressure between the spark electrodes exceeded 50,000 volts, and the frequency of the spark discharge 10 millions per second, that is, very much more than according to Majorana.

CONTRACTS OPEN AND CLOSED.

OPEN.

Carlisle.—November 1st. Two Lancashire boilers, two 50-kw. and one 30-kw. steam dynamos, 5-ton travelling crane, economiser, cables and boxes, wiring of buildings, switchboards, motors, fans, &c., for the Cumberland and Westmorland Lunatic Asylum. See "Official Notices" September 30th.

Dundee.—November 12th. Relaying copper strip mains with insulated cables. See "Official Notices" to-day.

Erith.—November 11th. Electric lighting of the offices of the Erith Education Committee at Picardy. See "Official Notices" October 21st.

Hammersmith.—November 15th. Electric wiring for the new workhouse and infirmary at Wormwood Scrubs; also two motor transformers and a battery for the Guardians. See "Official Notices" to-day.

Johannesburg.—December 27th. Transformer pillars and switchgear; also two 35-ton electric overhead travelling cranes, for the Municipal Council electrical undertaking. See two "Official Notices" to-day.

Preston. — November 9th. Motors and tramway boosters for the Tramways Committee. See "Official Notices" October 14th.

Roumania.—January 28th, 1905. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Shanghai. — March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Spain.—November 6th. The Municipal Authorities of Liria (province of Valencia) are inviting tenders until November 6th for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Liria (Valencia).

Swansea.—November 12th. Removal, alteration and re-erection of a 450-I.H.P. triple-expansion engine and a 225-KW. continuous current dynamo. Also an 8-ton travelling hand-crane, for the Electricity Department. See "Official Notices" October 14th.

Whitby. — November 21st. 200-KW. direct-current dynamo and high speed engine, also one water-tube boiler with chain grate stoker, for the U.D.C. See "Official Notices" October 21st.

CLOSED.

Brighton.—The T.C. has accepted the tender of Mr. Geo. Virgo, for installing the E.L., telephones and fire alarms in the diphtheria pavilion at the Sanatorium, at £152.

Burslem.—Tenders have been accepted for the erection of the electric light and destructor buildings at a cost of £3,745, and for the chimney shaft, at £850.

Devonport.—The T.C. has accepted the tender of Messrs. Willans & Robinson for the supply of an additional engine for the E.L. works, at £3,445.

Durban.—The tender of Messrs. Bruce Peebles & Co. has been accepted by the Natal and Durban Railways, Durban, for 40 motors, averaging 10 H P. each, for the locomotive shops.

East Ham.—The U.D.C. has accepted the following tenders:—Wiring new library, Messrs. Weston & Sons, £99 8s 4d.; 50 tons rails for tramway, Messrs. Dick, Kerr & Co., Ltd., £6 10s. per ton; granite setts for tramway duplications, Messrs. Griffiths and Co., 30s. per ton.

Erith (Kent).—The U.D.C. received the following tenders for the erection of car-sheds, workshops and offices, for the tramways:—

W. F. Blay, Dartford	£7,636 18 6
J. Eillingham & Sons, Dartford	7,720 0 0
Ennes Bros., Erith	8,364 0 0
Gunning & Sons, Erith (accepted)	7,215 0 0
Friday & Ling, Belvedere	7,843 12 0
F. Spencer & Sons, Erith	7,649 0 0

Exeter.—The tender of Mr. W. E. Blake, of Plymouth, for the superstructure of the tramcar-shed, at £4,265, has been accepted by the T.C.

G.P.O.—The Post Office has accepted the tender of the Sunbeam Lamp Co., Ltd., for 3 000 vacuum protectors.

Hackney.—The B.C. received the following tenders for arc lamp carbons:—

Name of firm.	A Positive 18 m/m × 12½" Negative 13 m/m × 11½"	B 16 m/m × 10" 11 m/m × 10"
Brockie-Pell Co., Ltd.	£3 19 8	£2 11 6
Brush Engineering Co., Ltd.	3 12 6	2 6 9
Crompton & Co., Ltd.	3 8 5	2 4 1
De Grelle, Houdret & Co.	3 6 10	2 5 8
Electrical Co., Ltd.	3 15 0	2 6 6
Fabius Henrion (accepted for 50,000 pairs)	3 4 2	(for 10,000 pairs) 2 1 5½
General Electric Co., Ltd.	3 7 0	2 5 0
International Co., Ltd.	3 19 0	2 14 0
Seeck, M.	3 9 4	2 4 11
Sloan Electrical Co., Ltd.	3 6 8	2 3 0
Siemens Appliances Co., Ltd.	4 14 0	2 14 0
Siemens Bros. & Co.	5 3 6	3 9 0

The same Council has placed an order with Messrs. Phillips and Co. for a grinder and accessories, at £42 10s.

London.—A contract has been let to the Walsall Electrical Co., Ltd., for the whole of the transmission of power, electric lighting, and a complete installation of their improved system of ventilation, for the slaughter houses of Messrs. Harrison, Barber and Co., of London, together with steam-driven generating plant.

India.—Messrs. Bruce Peebles & Co., Ltd., have received a contract through the India Office for generators, motors, motor-generators and balancers for railway shops, at £4,900, for the Onde and Rokilkhand Railway. For the Geelong Tramways they are also to supply a 500-E.H.P. lighting and traction direct-coupled set.

West Ham.—The Corporation on Tuesday accepted the tender of Messrs. P. & W. McLellan, Glasgow, for the whole of the tie bars, fish bolts and bonds, required for the new electric tramways.

FORTHCOMING EVENTS.

Friday, October 28th.—At 7 p.m. Institution of Electrical Engineers (Glasgow). Third annual dinner at the Grosvenor Restaurant.

At 5 p.m. Physical Society. "An Interference Apparatus for the Calibration of Extensometers," by Messrs. J. Morrow and E. L. Watkin, and other papers.

Saturday, October 29th. At 3 p.m. Junior Institution of Engineers. Visit to the National Physical Laboratory, Teddington.

At 7.30 p.m. Glasgow Technical College Scientific Society. "The Law of Workmen's Compensation," by Mr. W. Boyd Anderson.

Tuesday, November 1st.—At 8 p.m. Institution of Civil Engineers. Presidential address by Sir Guilford L. Molesworth, K.C.I.E., and presentation of medals and prizes.

Thursday, November 3rd.—At 8 p.m. Tramways and Light Railways Association, at the Society of Arts. "Notes on Permanent Way," by Mr. A. N. Connett.

At 8 p.m. Chemical Society meeting.

At 8.15 p.m. Röntgen Society. Presidential address.

Friday, November 4th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Students), at the School of Technology. "Electric Railways," by Mr. F. O. Mills.

Friday, November 11th.—Tramways and Light Railways Association. Visit to the L.C.C. power stations and car-sheds.

NOTES.

Electrical Power Afloat.—Mr. Henry Burrell, of 73, Robertson Street, Glasgow, sends us an interesting account of certain of his inventions which deal more particularly with the rapid handling of cargo on board ship. In Mr. Burrell's scheme the usual derricks have been dispensed with, while in their place is installed a complete system of electric cranes. These cranes are fixed two abreast, and are so placed that two pairs can work alternately into one hold, either with a port and starboard delivery, or into a double tiered warehouse. There are three motors to each crane, the hoisting, derricking, and slewing motors being 90, 26, and 12 B.H.P. respectively, while the cranes are designed for a working load of five tons.

The electrical energy is generated in a room in the after end of the vessel by steam turbo-dynamo sets of large size, the working voltage being 300. There is a common switchboard for power and lighting, and each crane has a separate D P. switch and fuse. The power is carried to the cranes by concentric cables, the outer conductor being earthed. On each crane-post there is a small switchboard fitted with a D.P. switch and fuse of the required size.

The three motions of the cranes are controlled by two controllers, so that the full range of the positions of the jib may be obtained without the operator changing his hands from one lever to another. While these cranes are well adapted for ordinary general cargoes, they are specially designed to withstand the heavy racking work of dealing with coal and ore by grabs. It is really in this class of work that their value is most pronounced, owing to the fact that no manual labour is required in the holes. As the hoisting speed is 160 ft. per minute, and, as stated above, the working load is five tons, the discharging capacity of the equipment is very high. For night work cluster lamps are fixed on the jib, which shine downwards and illuminate that part of the cargo on which the grap has to work, the grab itself closing automatically. A smaller size of turbo-set is provided for lighting and for controlling the starting engine from the navigating bridge, as well as from the forward bridge. Like the power system, the lighting is also concentric, and the deck, navigating, accommodation, and engine-room circuits, are separately controlled from the main switchboard.

We recently commented in our leader columns (April 29th, 1904) on the immense superiority of the electric motor-driven winch for ship work, and the advantages to be derived from its adoption in the modern cargo carrier cannot be over estimated. We are glad to think that this important matter will shortly take practical form.

London County Council.—At the meeting of the Council on Tuesday, the Finance Committee reported that the balance of the tramways renewals reserve fund at the beginning of last April amounted to £30,772, of which £12,015 was invested in November, 1901, in the purchase of £12,060 of 3 per cent. London County consolidated stock. On the recommendation of the Committee, and at the suggestion of the Highways Committee, the Council resolved to invest a further sum of £13,000, being a further portion of the amount standing to the credit of that fund, in the purchase of additional stock.

Government Telephone Wires.—The Local Government Committee stated that in connection with the forthcoming quinquenniel revaluation of property in London, they had had under consideration the question whether contributions in lieu of rates should not be payable in respect of Government telephone wires. It appeared from replies received from 22 out of the 29 assessment authorities, that in no instance does the Government make a contribution in lieu of rates in respect of telephone wires fixed for the Postmaster-General. Six of the authorities had been in communication with the Postmaster-General on the subject, and had been informed that the only Post Office telephone wires in regard to which any payment was made to local rates were the trunk mains acquired from the National Telephone Co. in 1896, and that the Postmaster-General denied liability to pay contributions in respect of any other telephone wires. The Committee proceeded to observe that the attitude taken up by the Postmaster-General was probably based upon legal decisions, to the effect that telegraph wires erected by the Post Office subsequent to the passing of the Telegraph Act, 1868, are not rateable, and that Government telephone wires were in the same category. The National Telephone Co. was assessed in respect of its wires, as also were the municipal telephones. It, therefore, appeared to the Committee to be inequitable that no contribution in lieu of rates should be made for the State telephone wires, and that the policy followed was contrary to the spirit of the Treasury minute of June 25th, 1874, which was to the effect that Government property should contribute to local rates on the estimated rateable value which would attach to such property if it were in private occupation. The matter was of importance to the Council and the local authorities, as, at the last valuation, the undertaking of the National Telephone Co. in London alone was assessed at £30,000. At the suggestion of the Committee, the Council decided to give authority for the Postmaster-General to be approached with a view to obtaining contributions in lieu of rates in respect of all Post Office telephone wires, and to ask the Borough Councils and Assessment Committees to take similar action.

The Conduit versus the Trolley.—The Council postponed for a week the consideration of a report by the Highways Committee recommending the expenditure of £22,500 on the construction for electric traction of the tramways already authorised along Rosebery Avenue. On this matter the Finance Committee make some interesting observations, which are given below, although they do not emphasise the words which we reproduce in italics. The Committee say:—"In submitting to us the estimate for the construction of tramways along Rosebery Avenue, to cover the cost of using an underground system of electrical traction, the Highways Committee point out that the Council's power for the construction of this tramway will expire in August, 1905, and that it is, consequently, very desirable that the work should be undertaken without delay. We should have preferred that the construction of this line should not be proceeded with until some definite decision had been come to as to the system of electrical traction to be adopted in the reconstruction of the northern system, but, under the circumstances, we offer no objection to the proposal. We presume, however, that in constructing this comparatively short length of line for the conduit system, the Council will not be considered as committing itself to *this system of traction, which is so much more expensive than the overhead system*, for the whole of the lines which will be connected with this particular line. The line, although it will be constructed for electrical traction, will, in the first instance, have to be worked by horse traction, and the Highways Committee propose to recommend the Council to enter into an arrangement with the North Metropolitan Tramways Co. by which the line will be worked by the company, the company paying the Council 8 per cent. per annum on the estimated cost, namely, £10,285, of constructing the line for horse traction, with an addition of £660 in respect of Parliamentary, &c., expenses, making £10,945 in all, so long as the line is worked by horse traction. When electrical traction is adopted on the tramway, in calculating the rent payable by the company, the amount by which the actual cost of constructing the tramway exceeds the estimated cost of construction for horse traction will be brought into account."

The Highways Committee presented reports in favour of the issue of "tokens" as tender for tickets on the tramways, but adversely to the provision of seats for the drivers and the conductors.

South African Notes.—(From our Durban correspondent.)—*Durban Tramways.*—At a meeting of the Durban T.C. on September 27th the Electric and Traction Committee recommended that five more tramcars be indented for at once, and five more at the expiry of six months, the question of alteration in design, if any, to be left to the new tramway manager on his arrival. This was, however, referred to a Committee of the whole Council. A further recommendation, to be carried out at once, was the duplication of the track from Lancers Road to the Junction, a distance of about ¾ mile, which was agreed to stand down. It was decided to augment the night service on the Berea from 30 minutes to 20 minutes. The Council approved of ordering the following additional plant:—

160 meters from Messrs. Ferranti, for private consumers.
15 Chamberlain & Hookham meters, for tramway feeders.
10 20-kw. "E.C.C." transformers, and 5 street boxes for the same.
2 boiler feed pumps (Weir) of 6,000 gallons per hour.

Also 6 miles of assorted cables, for which tenders are to be invited locally, most of the leading manufacturers being directly represented in Durban.

Kroonstad.—At a meeting of the T.C., Mr. Saunders, consulting electrical engineer, said, in view of the probability of the Council using electricity as the motive power for pumping water and running trains, it would be well to lay down extra plant now. Mr. Johnson, manager of the South African Transport Co., wrote, stating that if the Council would supply the capital necessary to put down the plant, namely, £3,000, and supply electric motive power and light, and would agree to take all responsibility for a breakdown in the machinery after three months, he would be prepared to deliver water at 6d. per 1,000 gallons, provided the Council agreed not to take less than 100,000 gallons daily. The matter was deferred.

Durban Telephones.—The underground conduit system for the Corporation new telephone system is practically completed. The new exchange is approaching completion, and a cable has been sent home to expedite the despatch of equipment and material.

Harrismith Electricity Works.—About a year ago Messrs. Mordey and Dawbarn, the consulting engineers to the Harrismith Corporation, issued their specification for the generating plant and station equipment of the new electricity works which it was intended to erect. Messrs. Mather & Platt, Ltd., were successful in obtaining the contract for the plant, which comprised an overhead travelling crane, two Morrin Climax water-tube boilers, with feed heaters and pumps, and two steel chimneys, two 80-kw. single-phase alternators, with a frequency of 50 cycles per second, and a full-load pressure of 2,100 volts, with direct-coupled exciters, and driven directly by two Howden enclosed compound engines, one 25-kw. set of similar design, two complete condensing plants with motor-driven centrifugal pumps, switchboard, and all cable connections and pipe work. The contract specified particularly that time was an essential consideration, and Messrs. Mather & Platt undertook to have the whole of the plant erected and at work within three months of the first consignment reaching Harrismith. This undertaking they have successfully carried out, as the first goods reached the works at Harrismith on June 14th, and on September 12th, their engineer was able to despatch a cablegram stating that all three sets of alternators were running on the town supply mains. All old customers of the Harrismith Engineering Co. have been connected up to the Corporation main supply, and about 20 new customers are receiving the light. A number of street lamps have also been connected and fitted with 32-c.p. lamps.

The Rating of Tramways.—At the Preston Quarter Sessions on Friday last, Mr. Worsley Taylor, K.C., presiding, the question came up for decision whether upon that part of the undertaking of the Blackpool and Fleetwood Tramway Co., which lies within the area of the Thornton Urban District, the company were entitled to be rated as if the undertaking were a railway, and therefore at only one quarter of its actual value. The matter arose on an appeal by the company against the rate levied by the Thornton Council. Their counsel, Mr. Taylor, K.C., contended that tramways were rated because they did not own land. This tramway, so far as it went through Blackpool and Fleetwood, was laid in streets and got the benefit of policing, lighting, and drainage, and therefore ought to contribute the full rates. But for a length beginning just outside the borough of Blackpool the whole of the land, except where it crossed the public roads, was freehold of the appellant company. It did not get the benefit of the rates, and it was fenced in. For the respondent Council Mr. Sutton urged that the tramway whilst passing through the respondent Council's district crossed numerous carriage-ways and had many stopping places. The Act of Parliament under which it was erected did not describe it as a railway at all, and the company were prohibited from carrying goods, excepting very small parcels. The Court dismissed the appeal with costs, holding that the undertaking must be treated as a tramway.

Shoreditch Electrical Exhibition.—A dinner in connection with this Exhibition was held at the Great Eastern Hotel, on Monday, 24th inst., the Mayor of Shoreditch being in the chair. A smoking concert followed, the programme being contributed to by various exhibitors and friends, also officials of the electricity department. A toast, proposed by Mr. H. F. Joel, "The Electrical Exhibition," was suitably replied to by Mr. C. Newton Russell; the toast, "The Vice-Chairman," was proposed by Mr. H. Marryat. The Exhibition was visited by no fewer than 24,000 persons in the course of the fortnight it was open, and throughout was a complete success.

Lord Armstrong on Education.—Lord Armstrong, on 21st inst., delivered his inaugural address as President at the annual meeting of the North-East Coast Institution of Engineers and Shipbuilders in Newcastle-on-Tyne. He spoke of the need of efficient means of technical education in order to get direct mental energy along proper lines. In this respect we were excelled by our great competitors, Germany and America, and our lack of progress in certain directions, and the extent to which we had fallen behind those countries, was partly accounted for by our deficiency in general technical training. We should be making a mistake if we specialised too much in our schools. School education should be directed towards making every man, according to his capacity, as useful as possible to the State, and, therefore, the reasoning faculties should be cultivated, but the mind should not be crammed with useless facts. At the same time, we could not afford to ignore the urgency of providing that a minority of our citizens should have, according to their circumstances and superior mental capabilities, special educational opportunities, and secondary knowledge should be encouraged by the formation of special educational centres throughout the country.—*The Times.*

Third Rail Electric Shock.—On the 18th inst. George Fraser (20), of 79, Virginia Street, Southport, an employé in the service of the L. and Y. Railway Co., was injured through coming in contact with the "live" rail. He received a severe shock, and his face was somewhat burned, necessitating his removal to the Infirmary. He is stated to be progressing favourably.

Scientific Education.—Sir Edward Grey, M.P., on the 20th inst., opened the new physical and engineering laboratory of the York Railway Institute. He said he was convinced that no country was more qualified by nature and brains to make use of good scientific training than our own, and, therefore, there was all the more reason why there should be good opportunities of acquiring it. In commerce we were not content with raw material, but worked it up into the finished article, and so with human beings, which were raw material, we should work them up into the highly-finished article of scientifically-trained intellects. In the great struggle for success everything depended on the use which we made of scientific discoveries.

Relay for Wireless Telegraphy.—If we are not mistaken, Dr. Lee De Forest, who is now on his way back to the United States, recently succeeded in *recording* signals transmitted on his original and ingenious system, and it is a matter for congratulation that this achievement was rendered possible by an English invention—namely, a wireless telegraph relay devised by Mr. H. W. Sullivan, who is well known as an assiduous worker in this art. The instrument, which is evidently the result of much thought and labour, is of remarkable sensibility, being capable of responding to telegraphic Morse signals with one Leclanché cell acting through a resistance of 250,000 ohms, while with the same battery power it will close a local circuit and ring an alarm bell through no less than from 1 to 1·5 megohms. An extremely important advantage claimed for the relay is that it is constant in its adjustment, and therefore always reliable and unlikely to fail at critical moments.

Durable Dynamos.—In a paper by Mr. A. D. Cairns read before the Queensland Institution of Engineers, it is stated that a 7-H.P. Crompton dynamo, installed in 1892, ran till 1895, lighting a works, and outlived two driving engines. The same machine was then put to drive a tool shop, and is running still. In its early days it was common for it to give 13 KW. output for six hours. Some figures are given in the paper, which may be useful:—

At 110 volts, a 600-lbs. churn fully charged absorbed 6 amperes at 35 r.p.m. A 1-ton butter worker fully loaded took 14 amperes. A heavy cut on a 3-in. steel shaft in a 10-in. lathe took 4 amperes. Screwing a 3-in. steam-pipe, 4 amperes. Five tin can presses, 4 amperes. A 24-in. Gardiner sandage machine at 500 r.p.m. required 15 amperes. A friction hoist to lift a 700-lbs. bullock at a speed of 60 ft. per minute required 16 to 18 amperes.

Electric Shock Fatality. — Another fatality has occurred in a coal pit in the county of Durham, at Eldon, near Bishop Auckland. Thomas Patterson (21), a miner, when searched for, was found dead, with his hands grasping the electric cable which supplies the current to the coal-cutting machines.

Appointments Vacant.—Borough electrical engineer and manager for Poplar Electricity Works (£400).

Faraday House.—We are informed that judgement was given in the action, Eason *v.* The Syndicate of Electrical Engineers, Ltd., on October 25th, in favour of the defendants, with costs. This was an action in respect to ancient lights at the back of the new Faraday House in Southampton Row.

Accidents.—A serious accident befel James Kirkland, an electrician in the employment of Messrs. Claud Hamilton, Ltd, Glasgow, on the 20th inst. He was engaged repairing some electric fittings in a repairing pit in a motor garage of Messrs. Rennie & Prosser, Ltd., when an explosion occurred. An accumulation of gas in the pit had become ignited by an electric spark. Kirkland, who was severely burned about the face and hands, was removed to the Royal Infirmary for treatment.

Erratum.—On page 692 of this issue, in connection with the gross receipts of the Manhattan Railway, the increase should read $1,979,348.28, and not as stated.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—The General Purposes Committee of the Blackburn Corporation have decided to separate the electricity and tramways departments, and to make the following appointments in connection therewith:—Mr. P. P. Wheelwright, at present chief assistant engineer, to be borough electrical engineer. Mr. W. H. Corson, at present station superintendent, to be chief assistant. Messrs. Leonard Johnson, the present assistant tramways engineer, and J. H. Cowell, traffic manager, are to be joint managers of the tramways department.

Mr. J. R. Cowley, of Perth electricity works, has been appointed to a position on the staff of the Lanarkshire Tramways Co.

Mr. J. W. Papworth, shift engineer at West Ham, has been appointed chief assistant engineer to the electricity department of the Kilmarnock Corporation.

Mr. J. G. Bruce, assistant distributing engineer at St. Pancras, has been appointed resident electrical engineer by the Willesden U.D.C.

Mr. E. de la Roche Rendell has been the recipient of a case of pipes and a silver matchbox from the employés of the Hanley Electricity Works, on the occasion of his leaving to take up a position with the Blackburn Corporation Electricity Works as shift engineer.

Seventy-three applications were received for the post of electrical engineer at Kroonstad. Mr. Richard Box, of Davis & Spain, Johannesburg, was appointed. The other candidates in the final running were Mr. J. Andrew, of Johannesburg, and Mr. J. McKenna, of Rhodesia.

The Hornsey Borough Electricity Works have appointed Mr. F. A. Watkins to be shift engineer for the vacancy recently announced.

On the 5th inst. the staff of the Reading Electric Supply Co., Ltd., held their fifth annual supper and smoking concert in a large oriental marquee erected and decorated by themselves within the spacious new engine room. All the arrangements, including the cooking, were carried out on the spot, and the menu consisted of such delicacies as roast boiler plate, ampere pudding, fire-clay fritters, &c. The chief, Mr. A. T. Cooper, was in the chair, and assisted in carrying out a long and enjoyable programme. The silver challenge cup, presented by Mr. J. V. Moinet for the best kept-up flower border within the works, was won by Mr. A. Russell, after a very keen competition.

The Swansea Corporation Electricity Department staff held a smoker last week at the Hotel Enterprise. Advantage was taken of the occasion to make a presentation of a leather kit-bag, suitably inscribed, to Mr. W. Welbury, one of the engineers, who is leaving to take up an appointment with the Stockton-on-Tees Corporation.

At the Bermondsey Electricity Works on 12th inst., Mr. J. W. A. Binner, chief assistant engineer, having been appointed as superintendent engineer to the Havanna Electric Co., Cuba, was presented with a handsome dressing case, cabin trunk and set of books by Mr. W. H. Vincent, Borough Electrical Engineer, on behalf of the staff and employés. Mr. Binner sailed from Liverpool on 14th inst. in the ss. *Celtic*, and his future address is La Companie de Electricidad de Cuba, Aguisi 81 and 83, Havanna, Cuba.

Tramway Officials.—Mr. John Young, of the Glasgow Corporation tramway system, is to be entertained to a complimentary banquet on the occasion of his leaving Glasgow for London. The function has been fixed to take place on Saturday, 29th (to-morrow).

General.—Arrangements are being completed for the installation of Lord Kelvin as Chancellor of Glasgow University, which has been fixed for Tuesday, November 29th. The ceremony is to take place at noon, in the Bute Hall of the University, following a meeting of the General Council.

Mr. Monkhouse, the consulting engineer of the Zanzibar Electric Light and Power Syndicate, left there recently *en route* for Mombasa. He is going to Nairobi (a correspondent states) on behalf of the syndicate, who intend including that town in their electric lighting scheme, and was to leave for Europe by the *Burgermeistir* on October 5th. He expressed himself very confident that the proposal is likely to prove very successful in Zanzibar, quite a large number of residents of all nationalities having given it their support.

From our contemporary *Electricity*, we learn that Mr. Y. Shinto, B.Sc., of Tokio, Japan, is now making a tour through New York and other parts of America, securing data for an exhaustive report on electrical matters to be submitted to the Japanese Government.

On Wednesday last week, Mr. W. B. Esson, M.Inst.C.E., M.I.E.E., was presented by the staff, foremen and workmen of Messrs. Johnson & Phillips's electric light and power works, with a roll-top writing desk and revolving chair as mementoes of the 10 years he had been associated with them while acting as chief engineer and manager to the firm. The presentation took place at the Charlton Works, Mr. E. A. Brandon, who had been Mr. Esson's chief assistant, acting as spokesman. In making a suitable reply, Mr. Esson remarked that from the nature of the gift which had been so generously bestowed upon him, it was evident that a good deal more work was expected from his hands.

Prof. Harry E. Clifford has been appointed acting head of the department of electrical engineering at the Massachusetts Institute of Technology, Boston, vice Dr. Louis Duncan resigned. Dr. Duncan has become electrical engineer to the New York Rapid Transit Commission.

NEW COMPANIES REGISTERED.

Garcin-Renault Electric Cars and Accumulators, Ltd. (82,299).—This company was registered on October 15th, with a capital of £20,000 in £10 shares, to adopt an agreement with P. Verhaeghe, and to carry on the business of dealers in, and factors and vendors of, motors, motor cars, motor yachts, launches, air ships, accumulators, cycles, and other vehicles of all kinds (whether propelled by electricity, steam, petroleum, alcohol, gas, or other motive power), mechanical, electrical and general engineers, manufacturers of motor accessories, &c. The first subscribers (each with one share) are:—P. Verhaeghe, 2, Golden Square, W., engineer; G. Drouile, 90, Avenue de la Republique, Paris, merchant; A. Renault, 20, Rue Folie-Mericourt, Paris merchant; L. Garcin, 35, Avenue Casimer, Arnie: es (Seine), France, engineer E. Guibet, 34, Avenue St. Mande, Paris, accountant; M. Duboys, 82, Boulevard Periere, Paris, gentleman; and A. Bosquet, 155, Rue Mickel Bizot, merchant. No initial public issue. The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first; qualification, 10 shares; remuneration, £40 each per annum (chairman £60).

Saxonia Electrical Wire Co., Ltd. (82,320).—This company has just been registered with a capital of £10,000 in £1 shares, to acquire the business of manufacturers of cables and insulated electric light and telephone wires, makers of leads, coil wires and picture and sash cords, &c., carried on by F. S. Thomas and S. T. Smith, as the "Saxonia Electrical Wire Co.," at Roan Works, Roan Street, Greenwich, and to carry on the said business and that of electrical and mechanical engineers, tool makers, iron and brass founders, &c. The first subscribers (each with one share) are:—Sir C. Smith, Kt., Falcon Wood, Shooter's Hill, Kent; Miss H. C. Smith, Falcon Wood, Shooter's Hill, Kent; C. H. Smith, Falcon Wood, Shooter's Hill, Kent, gentleman; F. S. Thomas, Welling, Kent, C.E.; S. T. Smith, Falcon Wood, Shooter's Hill, Kent, gentleman; T. W. Doran, 99, Park Lane, Clissold Park, N., clerk; and A. J. Hall, 19, Hamilton Road, Bromley, Kent, solicitor. No initial public issue. The signatories are to appoint the first directors; qualification, 100 shares.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newton's, Ltd. (48,936).—This company's annual return was filed on September 30th, when 3,265 shares had been taken up out of a nominal capital of £40,000 in 4,000 shares of £10 each. £10 per share had been called up on 1,865 shares, resulting in the receipt of £18,650. £14,000 is considered as paid on 1,400. Mortgages and charges: £10,000.

Ackroyd & Best, Ltd. (54,600).—This company's annual return, made up to September 21st, has been filed. The capital is £25,000 in 2,000 preference, and 1,800 deferred shares of £5 each, of which 1,986 preference and 1,800 deferred have been taken up. £5 per share has been called up on the preference, and £9,080 has been paid. £9,000 is considered as paid on the deferred shares. Mortgages and charges: £16,750 (exclusive of £3,500 floating debentures to cover bank and guarantors of bank overdraft).

Issue on September 14th of £1,250 10 per cent. debentures, part of series created March 3rd, 1904, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: C. T. Naylor, Dean House, Kilmeston, Alresford; and J. P. Humble, Threelands, Birkenshaw. Previously issued of same series, £2,600.

Yale Electric Power Co., Ltd. (60,493).—This company's annual return was filed on October 12th, when 605 shares had been taken up out of a nominal capital of £20,000 in £800 shares of £25 each. £25 per share has been called up on 537, resulting in the receipt of £13,375. £50 remains in arrears. £1,700 is considered as paid on 68 shares. Mortgages and charges: nil.

Hughes' Atlas Works, Ltd. (82,229).—£6,000 debentures created 7th and dated October 8th, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. A charge on the company's undertaking and property, present and future, dated October 8th, 1904, to secure £4,000, has also been registered. Holders: Sir A. Dent, K.C.M.G., and E. Dent, 78, Gracechurch Street, E.C.

Northern Counties Electricity Supply Co., Ltd. (67,924).—Issue on September 22nd of £10,000, and on October 6th of £700 mortgage debentures, part of series created February 18th, 1904, to secure £100,000. Property charged: The company's undertaking and property, present and future, except uncalled or unpaid capital. Holders: York City and County Banking Co., Ltd., Newcastle-on-Tyne; H. Cleveland, Bolton Crofts, Richmond, Yorks; W. W. Whytehead, 6, Whitehall Place, S.W.; H. E. Cradock, Manor House, Rushyford, Ferryhill; R. G. H. Boulton, 3, Church Square, The Stray, Harrogate; and W. W. Boulton, The Towers, Ammouth. No trustees. Previously issued of same series: £66,100.

Perth Electric Tramways, Ltd. (55,935).—Issue on October 6th of £100 6 per cent. debentures, part of series created December 22nd, 1903, and covered by trust deed of December 30th, 1903, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital, benefit of certain agreements, tramways in Perth, W.A., &c. Trustees: Lord A. Butler, 7, Portman Square, W.; and J. S. Austen, 68, Dashwood House, E.C. Previously issued of same series: £35,000.

Royce, Ltd. (63,871).—Issue on October 7th of £1,900 debentures, part of series created March 27th, 1903, to secure £25,000, charged on the company's undertaking and property, present and future, except uncalled capital. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. Previously issued of same series: £23,100.

South Metropolitan Electric Light and Power Co., Ltd. (47,875).—Issue on September 23rd of £53,292 debentures, part of series created by resolutions of July 3rd, 1900, and May 6th, 1904, to secure a sum not exceeding in the aggregate the amount of the share capital issued and paid up for the time being. Dates of trust deeds: August 3rd, 1900, and June 3rd, 1904. Property charged: The company's undertaking and property, present and future, including uncalled capital (as a floating security, except as to freehold or leasehold hereditaments for the time being comprised in the said trust deeds). Trustees: H. R. Beeton, 18, Austin Friars, E.C.; and W. R. Davies, 10, Moorgate Street, E.C. Previously issued of same series: £120,000.

Mexico Electric Tramways, Ltd. (56,932).—A trust deed dated September 21st, 1904, to secure £500,000 second debentures has been registered. Property charged: Certain ordinary shares and second mortgage debentures held by the company in the Compania de los Ferrocarriles del Distrito Federal de Mexico, and the company's general assets. Trustees: L. Breitmeyer and C. Rube, 1, London Wall Buildings, E.C.

Ernest Scott & Mountain, Ltd. (22,760).—This company's annual return was filed on October 10th, when 97,790 ordinary and 28,700 preferred ordinary shares had been taken up out of a nominal capital of £150,000 in 100,000 ordinary and 50,000 preferred ordinary shares of £1 each. £1 per share has been called up on 75,790 ordinary and 28,700 preferred ordinary shares, resulting in the receipt of £104,240. £250 remains in arrears. A further £4 10s. has been paid on one forfeited share of £10 nominal value. £23,000 considered as paid on 22,000 ordinary shares. (Capital was originally £70,000 in £10 shares, and was increased to £100,000 in £10 shares in 1897. 50,000 new shares of £1 each were created in March, 1904, and the existing £10 shares were sub-divided into £1 shares.) Mortgages and charges: £20,100.

Gorseinon Electric Light Co., Ltd. (39,944).—This company's annual return was filed on August 12th, when the entire capital of £1,000 in £1 shares had been taken up. £1 per share had been called up and £990 10s. received, £9 10s. remaining in arrears. Mortgages and charges: £800.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—A memorandum of satisfaction in full of debentures dated October 19th, 1901, February 18th, March 25th, April 29th, September 30th, and December 2nd, 9th, 18th and 30th, 1902, February 3rd and March 31st, 1903, and March 7th, 1904, to secure in all £23,900, has been filed.

British Prometheus Co., Ltd., Kingston-on-Thames (74,889).—A debenture dated October 17th, 1904, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holders: A. R. Phipps and J. F. Bedford (trading as Bashleigh, Phipps & Co.), 147, Oxford Street, W.

Empire Electric Light and Power Co., Ltd., London (75,545).—A first mortgage debenture, dated October 12th, 1904, to secure £5,500, charged on certain lands, machinery, works, plant, effects, lighting and tramway orders and Acts, and the company's undertaking and other assets, including uncalled capital, has been registered. Holder: L. K. Jarvis, Mead Lodge, Hunsdon, near Ware.

County of London Electric Supply Co., Ltd. (34,320).—An acknowledgement of indebtedness, dated October 18th, 1904 (supplemental to a trust deed of May 12th, 1903), securing a further £150,000 second debenture stock, has been registered. (The trust deed empowers the company to issue further debenture stock, ranking *pari passu* with the £250,000 therein mentioned, provided that the total shall not at any time exceed £400,000.) Property charged by said trust deed: The present and future assets of the company (as a floating security), ranking next after a deed securing a maximum of £400,000 first debenture stock. Trustees: Electric and General Investment Co., Ltd., 1-2, Great Winchester Street, E.C.

Chilian Electric Tramway and Light Co., Ltd. (57,203).—This company's annual return was filed on September 13th, when 500,000 ordinary and 600,000 preference shares had been taken up out of a nominal capital of £1,150,000 in 500 000 ordinary and 650,000 preference shares of £1 each. £600,000 has been received in respect of the preference. £500,000 is considered as paid on the ordinary. Mortgages and charges: £500,000.

Cutting Brothers, Ltd., Electrical Engineers, Derby and London (81,178).—Issue on September 26th of £200 debentures, part of series created June 20th, 1904, to secure £4,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £2,600.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on September 26th of £28,400 5 per cent. debentures, part of series created July 14th, 1904, to secure £35,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series. (A note is appended to the return to the effect that the previous issue of debentures has been fully satisfied.)

ELECTRICITY SUPPLY ACCOUNTS.

Hackney Municipal Electricity Supply.

This, the second year's working of the Hackney undertaking, has proved not less satisfactory than its predecessor. The output has gone up, power units forming a considerable proportion of the increase; and helped by a load factor of nearly 17 per cent., and improved working costs, the department netted a gross profit of some £16,000, which was apportioned to financial charges and to providing a substantial contribution to reserve. A large proportion of the steam used by the electricity department is supplied by the refuse destructor worked in conjunction with the station.

The prices charged are:—Private lighting, a flat rate of 4d. per unit; power, 2d. per unit for the first 1,000 hours, and 1½d. afterwards. The chief engineer is Mr. L. L. Robinson.

GENERAL STATEMENT.

For year ending March 31st—	1904.	1903.
Total capital expended	£246,576	£215,191
Number of units sold—		
Private supply	1,598,916	1,075,962
Public lighting	582,475	539,006
Total number of units sold ...	2,181,391	1,614,968
Equivalent No. of 8-C.P. lamps connected...	94,816	68,897
H.P. of motors connected	614	381
Number of public lamps	293 arcs	293 arcs
Maximum load in KW.	1,479	1,161
Revenue account—		
Gross revenue	£26,692	£21,368
„ expenditure	£10,502	£7,835
„ profit	£16,190	£13,533
Average price obtained per unit—		
Private lighting	3·23d.	3·37d.
Public lighting	2·00d.	2·70d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

Gross revenue	£26,692 = 2·94d. per unit.	
Works and distribution costs (including public lighting)	£7,681 = ·84d.	„
Total working costs	£10,502 = 1·15d.	„

PROFIT STATEMENT, 1904.

Interest on loans	£6,577
Sinking fund	1,682
To reserve fund for accrued principal and interest	2,451
To reserve fund—Net profit for the year ...	5,546
Balance accumulated and brought forward ...	—66
Gross profit	£16,190

HACKNEY DESTRUCTOR DEPARTMENT.

This department dealt with 39,175 tons of refuse, as compared with 34,006 tons in the previous year. From this was recovered some 201 tons of tin and scrap iron, 17,418 tons of clinker, flue dust and fine ash. The average quantity of water evaporated per lb. of refuse was ·519 lb., as compared with ·543 lb. in 1902-3. The total amount of steam supplied to and utilised by the electricity department was 45,628,769 lbs., as compared with 41,411,970 lbs. in the previous year.

The following is an analysis of the destructor costs for the years ending 1903 and 1904:—

		1904.	1903.
Oil, waste, water and stores	£53	·33d.	·43d.
Electricity	739	4·53d.	4·66d.
Wages of workmen	£3,611	22·12d.	19·11d.
Repairs and maintenance	£467	2·86d.	·34d.
Clinker disposal	£10	·06d.	5·27d.
	£4,880	29·90d.	29·81d.
Management, &c.	£537	3·29d.	2·15d.
Total works cost and management ...	£5,417	33·19d.	31·96d.
Financial charges	£1,926	11·80d.	19·5d.
Total expenses, including all charges	£7,343	44·99d.	51·4d.
Income from electricity department, &c.	£2,513	15·40d.	16·0d.
Balance, being cost incurred by Public Health Department	£4,830	29·59d.	35·4d.
Per ton of refuse	2s. 5½d.	—	2s. 11½d.

CITY NOTES.

Electrolytic Alkali Co.

The annual meeting was held at Liverpool on 20th inst.

Mr. C. C. Connor, in moving the adoption of the report, said the board regretted they had not better results to put before the meeting, but the smallness of the profit was to be attributed to the general dulness of trade and the very low price of bleach during the year. They had had 12 solid months of the lowest prices for bleaching powder that they had had for a great many years; but, so far from the result being an unsatisfactory one from a working point of view, he thought they had done very well, having allowed for depreciation, and even showed a small profit. The productive power of the plant had been increased, with the beneficial result that they had been able to produce a ton of bleaching powder at less cost than a year ago.

Col. Pilkington seconded.

According to the *Financial Times*, Mr. W. B. Longsdon moved an amendment that the meeting be adjourned, that a committee be formed to inquire into the position of the company, and that new directors and auditors be appointed.

Mr. McDonald seconded, and, after discussion, the Chairman said the board would not object to the amendment, though they had the voting power to do so if they wished. The directors were willing to have investigation, as they were convinced it would show that there was no foundation for any allegations of mismanagement. He warned the meeting that, when the investigation was closed, he would exercise all his power, as one of the largest shareholders, to prevent publication of any details that would injure the company.

The amendment was then agreed to as far as the report to a committee was concerned, and the meeting was adjourned till 24th prox.

Cuba Submarine Telegraph Co.

Mr. C. W. Parish, presiding at the meeting of the company on 19th inst., said that, so far as actual figures were concerned, they were very similar to those for the same period of 1903. The traffic receipts for the half-year amounted to £16,526, as against £17,244, a falling off of £718; but this falling off arose mainly in the month of June, when the Manzanillo-Santiago cable became interrupted. Then, interest receipts were rather larger, so that the total income was £18,715, as compared with £19,325 in 1903, or an actual reduction of £610. The expenses during the half year were rather heavy, and totalled £6,369, which was £303 increase, and was due to additional expenses at various stations. But besides their usual working expenses they had had to write off the special cost of the attempted repair of the Cienfuegos—Santiago 1875 cable, which amounted to £7,670. He referred to that matter at the last meeting, but the payments in connection with the hire of the repairing ship were now included in the accounts before them. The ordinary expenses and the special outlay amounted together to £14,039, which, deducted from the £25,686 they had to the credit of revenue, including £6,970 brought forward from the previous half-year, left £11,647 to deal with. The preference dividend required £3,000, and they proposed to pay a dividend at the rate of 5 per cent. per annum on the ordinary shares, and to carry forward a balance of £4,647. This, he thought, they could consider a satisfactory outcome of an unfortunate half-year. The manufacturer had made good progress with the new cable from Cienfuegos to Santiago, and if all went well they might have it working before the end of the year. He had every expectation of getting an exceptionally good cable. He noticed that Mr. Hooper, who was manufacturing the cable, was present, and he would understand that they expected an extra good cable. The Manzanillo—Santiago became interrupted on June 14th, which was the date of the great storm which fell on the south-eastern portion of the Island of Cuba, and they were now of opinion that there must have been at the same time a great disturbance along the coast at the bottom of the sea. Probably some form of eruption took place which was so severe that it actually broke the cable in two. The depth of water was very great, and there was an uneven bottom with banks of rocks, and the experience they now had pointed to it being a peculiarly unsafe place for cables to rest upon. The rocks gradually cut the cables, and, further, they made it most difficult to successfully repair any breakages. The West India and Panama Co. kindly agreed to hire them their repairing steamer to try and repair the break. They worked on the spot for some time, and finding the cable could not be recovered near the break, they came to the conclusion that it would be necessary to change the position of the cable, and take a considerable part of it further out to sea, away from the rocky, uneven bottom, where they would get far safer ground. They were now sending out the extra cable which would enable the cable to be diverted, and when this was done, they expected to work many years without interruptions. In the meantime they were working under some difficulties, and until the new cable was laid he feared they must expect a decrease in the traffic. They were still waiting news of their application to the United States Government for the payment of the expense they were put to by the cutting of their cables during the Spanish-American war, and their representative in Cuba had not yet succeeded in obtaining from the Government their subsidy for the coast cables. They trusted in time to arrive at a satisfactory settlement, but these continual delays were very disheartening. So far as the Island of Cuba was concerned, they had very good reports. The planting of sugar and tobacco was increasing, and this was the main indication of considerable prosperity. The successful issue of the loan which the Cuban Government were able to carry through would bring a large sum of money into the Island, and he hoped that from the movement of that money there would be a considerable expansion of business all round.

Mr. George Keith seconded the motion.

Replying to Mr. O'Brien, the Chairman said they had been working their traffic since the break in the cable, mainly through the land lines. It did not go through Bermuda.

The report was adopted, and the Chairman re-elected a director of the company.

Bath Electric Tramways, Ltd.

Sir Vincent Caillard presided at the annual meeting held at Winchester House on Tuesday. He moved the adoption of the following report to December 31st, 1903:—

The construction of the company's system was proceeding during the whole of the period up to the end of last year, and the accounts now submitted relate entirely to construction. The directors, however, are pleased to record that the tramways started working on January 2nd, 1904. Upon that date the operation of the system commenced with a small part of the mileage and with some few of the tramway cars. Both the mileage and equipment have been increased from time to time during the current year, and various sections of the line were at various dates completed and opened, until on August 1st last the final section of the system originally contemplated by the company was opened for traffic, and 40 tramway cars were in use. The traffic receipts from the commencement of operations to September 28th, 1904, that is for a period of 39 weeks (less two days), amounted to £25,365 0s. 4½d., a result which may be considered satisfactory.

It is proposed to submit to a meeting, to be held early next year, the accounts for the year to December 31st, 1904, which will include the first 12 months' operations of the company.

The Chairman regretted that the report was so late in appearing, but the time had been usefully occupied in pressing forward the completion of the construction of the system. The balance-sheet called for little explanation; it really was scarcely more than a construction account. In regard to the preliminary expenses, a good proportion would ultimately be charged to capital expenditure, but up to the present it had been impossible to allot accurately all the items under their proper headings; that would be done in the next balance-sheet. The total track mileage of the system was 16¾ miles and the total route mileage 12½. The system was completed on August 1st, 1904. There was an additional route to be constructed over the Midland Railway Bridge over the Avon, which would shorten the route to one of the important suburbs of Bath. The additional expenditure involved would be more than compensated for by the traffic receipts that would result therefrom. Under the company's original order they were bound to provide £11,500 for street widening, wayleaves, and any other city improvements which the Corporation might call upon them to make. They had now made a later arrangement under which by paying an additional £5,000, making £16,500 altogether, the Corporation undertook to re-construct the Midland Railway Bridge for carrying the company's tramways, and liberated the company from any call in the future for any further city improvements of any kind. Those who had followed the published figures relating to the company's traffic receipts, would have been pleased with the satisfactory course they had taken. Since the whole system was finished on August 1st, the receipts had been maintained in a satisfactory way at the high level then reached. They did not consider it excessive optimism to say that after a year's working they would compare with any other system in the United Kingdom. Former opponents in Bath had now considerably changed their minds, and the company had received petitions to extend its system to fresh routes. Up to the 12th inst. they had carried 3,545,900 passengers, thus they had already carried the whole population of Bath 70·4 times over, and that in spite of the fact that the complete system had been running for little over 12 weeks. It was dangerous to prophesy, but they had good grounds for anticipating that their receipts would average £730 per week. They were just on the point of making an issue of debenture stock with which they would clear off their indebtedness and place themselves on a perfectly sound footing. The unissued share capital would be issued later, they hoped, when more extensions became necessary, and by that time the market would be a good one for their shares. Most probably the next annual meeting

would take place early in the new year at Bath, as inhabitants of Bath had been showing their confidence in the system by becoming shareholders.

The report was adopted, and complimentary remarks were made respecting Mr. R. D. McCarter, the manager, the directors, the staff.

Drake & Gorham, Ltd.

The third annual report for the year ended June 30th, 1904, reads:—

After payment of all charges, including bonuses due to staff, there remains a net profit of £8,648 19s. 9d., which, with the sum of £2,573 4s. 7d. brought forward from the previous year, makes a total of £11,222 4s. 4d., which it is proposed to appropriate as follows:—

By payment of a dividend at the rate of 6 per cent. per annum		£7,500	0 0
By placing to reserve	£2,000 0 0		
By carrying forward	1,722 4 4		
		3,722	4 4
		£11,222	4 4

With the above addition the sum placed to reserve will amount to £9,000.

In view of the general financial stringency and increased competition for any installation work required during the period under review, it is considered that the results should not be regarded as disappointing, especially when it is remembered that the previous year was considerably above the average. A contract has been obtained for a central generating station at Church Stretton, for the supply of about 3,000 lights, the plant and buildings of which have been designed by the company's staff, and will shortly be available for use. A smaller station for the public lighting of Uphall and Broxburn is also being erected by the Scotch branch. A large private installation at Brancepeth Castle, for the Right Honourable Lord Viscount Boyne for the supply of 1,150 lights, has been completed by the Manchester branch during the year with very satisfactory results, and the company have in hand at the present moment the lighting of Gordon Castle and Goodwood, for His Grace the Duke of Richmond and Gordon, and other important contracts. The company have taken advantage of the opportunity afforded by the slack period to prepare a treatise on the application of electric current to all estate requirements, which cannot fail to be of value in the future. The company's S.S. system of lighting continues to give satisfaction, and improvements are introduced from time to time as the result of experience gained. Every effort is made to reduce expense where this can be done without risking the ultimate efficiency of the apparatus. Mr. Edwin H. Story, who accepted a seat on the board since the last annual meeting, is now, in accordance with the articles of association, put forward for re-election.

[The dividend for the previous year was 8 per cent., and for the year before that, 7 per cent.]

Western Telegraph Co.

The report of the directors for the half-year ended June 30th, 1904, reads:—

The revenue for this period amounted to £241,931 7s. 1d., and the working expenses to £99,547 12s. 8d. After providing £18,868 7s. 2d. for debenture stock and debenture interest and sinking fund, and £5,893 6s. for income-tax, there remains a balance of £122,672 1s. 3d.; to this is added the sum of £4,939 14s. 5d. brought forward from December 31st last, making a total of £127,611 15s. 8d. The revenue includes £17,114 11s. 5d. dividends upon the company's investments in other telegraph companies, and £7,322 1s. 1d. interest on reserve fund investments. A quarterly interim dividend, amounting to £31,189 10s., has been paid, £22,000 transferred to the general reserve fund, and £18,000 to the maintenance ships' reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £51,982 10s., leaving a balance of £4,439 15s. 8d. to be carried forward. The dividend and bonus will be payable on November 3rd.

County of London Electric Supply Co.—The letters of allotment and regret in respect of the recent issue of £150,000 4½ per cent. second debenture stock have been posted.

West African Telegraph Co.—The directors have declared an interim dividend for the six months ended June 30th at the rate of 4 per cent. per annum.

Marconi's Wireless Telegraph Co.—The directors have conditionally allotted to the shareholders, in proportion to their holdings, 30,000 shares of £1 each, at the rate of one new share for every seven shares held on October 24th, at the price of £1 per share.

Prospectus.—*The Bath Electric Tramways, Ltd.*, is inviting applications for £135,000 4½ per cent. first debenture stock at par. The proceeds of the issue will be applied to clearing off existing charges, repaying the indebtedness of the company, the completion of a connecting line across the Midland Railway Bridge, and to the general purposes of the company. The annual report and meeting of the company are referred to on page 717.

STOCKS AND SHARES

Wednesday Evening.

After receiving a momentary check by reason of the North Sea outrage, business in the Stock Exchange quickly recovered its expanding tendency, and there is a respectable amount passing in most of its departments. Only the mining markets remain somewhat apathetic. Investment continues the order of the day, and, with money plentiful, the House looks forward to a brisk couple of months' run before the Christmas holidays. Prices are not yet so well established but that any unexpected international complications would fail to bring about a sharp relapse, although the substantial amounts of stock and shares being bought for actual payment is a slight guarantee that no sustained slump need be looked for unless, as members of the Stock Exchange say, the skies fall in.

Electrical issues have little but the feature of steadiness to display this week. As stated above, the crazy Russian onslaught checked trade a little, causing orders to be taken off, and suspending animation for a while. The effect of this soon disappeared from the general markets, but in the more restricted area of the electrical sections it did not wear off quite so quickly. One significant fact of the confidence in which the good stocks are held is seen in the ready response of the County of London shareholders to the Second Debenture issue. The underwriters were released from all responsibility, except for the stock which they wished to take "firm." As one or two of the more sensational financial writers have treated the issue with an unnecessary degree of suspicion, we may observe that the underwriting terms were 2½ per cent. Bath Electric Tramways is making an issue of 135,000 4½ per cent. debenture stock at par.

Central London Ordinary stock has moved up to 93, and a buyer who tried to get it at 92½ found himself rather out of the market. The dealers are not eager to make prices in a stock when they receive slender support from the sources that generally supply or take that stock, and the consequence is, that Central London descriptions are exceedingly difficult to negotiate on the basis of businesslike quotations. The Deferred has risen two points to 82. Metropolitan Ordinary was done at 101⅜, but Districts keep about 42½. East London Ordinary at 5½ is a trifle harder, and we would point to this company's second 4 per cent. "B" Debenture stock as a good security to put away for a 10 or 15 points' rise. The nominal quotation is 35 to 40. Actually, it is more like 36 to 38. The whole issue amounts to £382,000, and for 1903 the stock received 15s. per cent., paid last January. By virtue of the arrangements of the East London with the District, it would not be surprising if this second "B" Debenture were to be put up to nearer 60 within the next 12 months. It seems hardly necessary to add that the stock must be regarded as a purely speculative investment. Underground profit-sharing notes hardened ¼ to 99¼.

With reference to our recent hint about South Wales Power, it may be stated that there has been a buyer of 500 shares on the market this week at 8½, and he had to advance his price before getting even 100 of them. The Debenture stock is 103½.

British Westinghouse Preference have improved to 3¾ middle, a rise of over 20s. from the lowest touched lately. The demand appears to be inspired by the "other side," and interest is agog as to whether the directors will declare a dividend. The last was paid in February. At 88½ the Debenture stock is better. British Thomson-Houston Debenture stands at 101. Traction varieties as a whole are very steady. Anglo-Argentine Trams at 7, and the Preference at 5½, retain all their strength, and Auckland Debenture changed hands at 105 a few days ago. On the same day, Calcutta Debenture was done at 107. Metropolitan Electric Trams Debenture again hardened to 102¼, and business has been marked in Colombo Electric Tramways 5 per cent., Debenture at 105. British Electric Traction Preference rose ¼ to 11¼, and the Ordinary are 10, as they were last week, although a printer made us give them a £60 rise to 70! There is a fair amount being done in Belgranos, the Ordinary at about 3⅞, and the "A" Preference about 5⅝, while City of Buenos Ayres Trams are 10½. British Columbia Electric Deferred, after being quiet since the fire, are 3 up at 104½.

Changes in the Electricity Supply section are not numerous. County of London are firmer upon the success of the Second Debenture issue, and Citys keep hard at 10⅞. Edmundson's Preference at 6½ have lost their slight improvement, but London Electric Preference rose to 5⅞, by reason of the excellent earnings reported by the company. South Metropolitan First Debenture advanced to 107½, as we contended that it would do in the days when the company was the Blackheath and Greenwich. St. James's shares remain dull at 14½.

Anglo-American Telegraph stocks are rising again, and the Deferred is up to 8½ middle. The "Jungle" boomlet drew attention to West African Telegraph shares, which are 10s. better, at 7. Eastern issues show very little alteration, and a rise of 1 in Eastern Telegraph Preference is the only quotable change, although the lines to the Far East must now be working at high pressure. Telephone stocks are more active, and National Deferred has got to within 3 points of par. Monte Video shares are firm at 12s. 6d., but United River Plates have not moved.

Amongst Miscellaneous shares, India-Rubbers are 10s. to the good at 20. A correspondent asks what dividend Henley's have paid this year, and the reply is, 14s. per share. The last distribution of 5s. was an interim, and the yield to a buyer at the present price of 11, is £6 7s. 3d. per cent. on the money.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Oct. 19th.	Closing Quotations Oct. 26th.	Business done week ended Oct. 26th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 8⅛	2⅛— 8⅛	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	49 — 52 xd	49 — 52	50	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	96 — 98 xd	96 — 98	97⅜	96½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7⅜— 8⅛	8 — 8⅛	7⅝	7⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5⅛	5⅛ — 5⅜	5⅜	5⅛
18,888,800$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96	93 — 96	94⅜	93½
16,000	Cuba Telegraph	10	4 %	6½ %	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
6,000	Direct Spanish Telegraph	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101%	..	..
60,710‡	Direct United States Cable	20	8½%	8½%	8 %	10½ — 10⅝	10½ — 10⅝	10⅝	10⅞
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	131 —136	133 —137	136	133
1,955,555	Do. 3½ % Pref. Stock	100	..	..	..	86 — 89 xd	87 — 90	88¾	87½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	108	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12½ — 13 xd	12½ — 13	12⅝	12⅛
320,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	107½	106¾
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	100 —103	100 —103	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104	101 —104	101	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	9½— 9¾	9½— 9¾	9⅛	9⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	13¾— 14½	13¾— 14½	14	13¾
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28½— 29½	28½— 29½	28¾	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44 — 47	44 — 47	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	2½%	3 %	3 %	⅞ — 1	⅞ — 1	..	..
1,988,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	106 —108	104 —106	107⅜	106½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	96 — 98	96 — 98	97⅜	96
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅜
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98½	97½
689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104 —106	104 —106	105½	105
1,000,000	Do. do. Prov. Certs., 85 % to be paid	..	..	..	..	67 — 69	67 — 69	67½	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	⅛— 1⅛	⅛— 1⅛	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛— 1¼	1⅛— 1¼	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¾— 7 xd	6¾— 7⅛	..	..
3,808	Submarine Cables Trust	Certs.	..	..	..	117 —122 xd	117 —122	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6½— 6⅝	6½— 6⅝	6½	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	5⅛	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,669	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6½— 7½	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	1/16— 3/16	1/16— 3/16	1/16	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	97 — 100	97 —100	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12½ — 13	12½ — 13	12⅝	12⅞
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —104	101 —104	..	..
98,321	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	7/16	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 7	6½— 7	6¾	6⅝
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5½— 6	5⅝	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8½— 9½	8½— 9½	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	94 — 98	96 —100	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅜— 10⅛	9⅜— 10⅛	10⅜	..
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10⅜— 11⅛	11 — 11⅛	11⅜	11⅛
600,000	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	115 —118	116 —119	118⅛	118
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	94 — 97	96 — 97	97	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅛— 6	5⅛— 6	5⅞	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 6	5⅛— 6	5⅞	5¹¹⁄₁₆
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Brown, Lindley & Co., Ord.	£1	Nil	..	..	⅝— ¾	⅝— ¾	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	3	Nil	Nil	Nil	½— ⅝	½— ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	3	8 %	6 %	6 %	1 — 1½	1 — 1½	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
'25,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	70 — 75	70 — 75	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10½	9½— 10½	9⅝	9⅜
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	102 —105	102 —105	103⅜	102
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	89 — 92	91 — 94	94	93½
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	100 —102	100 —102	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	81 — 83	81½	79½
1,880,000	City and South London Railway	Stock	2 %	3½%	2½%	47 — 49	47 — 49	48	..
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1½— 2	1½— 2	1⅞	1⅞
100,000	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,028‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 83	78 — 83	80	78½
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1½— 1⅝	1 — 1½	1½	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2 — 2½	2 — 2½	..	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	9½	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10½— 11½	10½— 11½	11½	10½
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
45,300	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —111	108 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	19½ — 20½	20	19⅞
600,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	2⅜— 2⅝	2⅜— 2⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
17,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	36 — 39	36 — 39	..	..
150,000‡	Do. do. 4 % Deb. Bds., Nos 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
640,000‡	Waterloo & City Railway Ord. Stock	100	3 %	3½%	3½%	86 — 89	86 — 89	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Oct. 19th	Closing Quotations Oct. 26th.	Business done week ended Oct. 26th 1904, Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£ 5	8%	8 %	10 %	10¼— 11	10¼— 11	10¼	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10¾	10¼— 10¾	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	8¾— 9	8¾— 9	9	8⅞
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 5⅝	5¼— 5¼	5⅝	5⅞
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4¾— 5	4¾— 5	..	..
40,000	Do. do. 1903	5	..	..	..	4¾— 5	4¾— 5	4⅝	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	104½	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	6¾— 7	6¾— 7	..	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	110½	110
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10¾ — 11	10¾ — 11	10¾	10½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	122 —126	122 —126	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	..	..	..	103 —106	103 —106	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8¾— 9¼	9 — 10	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11¾— 12¼	11¾— 12¼	12⅛	..
400,000	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	102 —105	101 —104	103¾	103½
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6⅛— 6⅜	6⅛— 6⅜	6⅛	6⅛
70,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6⅜— 6⅝	6 — 6⅛	6⅜	6⅛
300,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12½	12 — 13	12 — 13	12⅛	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	101 —104	103½	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞— 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛— 6	5⅛— 6	5⅛	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	97½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6½%	7½%	8½%	15⅞— 16½	15⅞— 16½	16⅝	15⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5¼— 5½	5¼— 5½	5½	5⅛
200,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	112 —117	112 —117	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,862	Notting Hill Electric Lighting	10	6 %	6 %	6 %	14½— 15½	14½— 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2⅜— 3½	2⅜— 3⅝	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	3 %	4¼— 4⅜	4¼— 4⅜	4¼	4⅛
100,000	South Metropolitan Electric Light and Power Ord.	1	..	..	..	¾— 1	¾— 1	..	..
50,000	(*Late Blackheath and Greenwich* 7 % Pref.	1	..	..	..	1⅛— 1⅛	1⅛— 1⅛	1⅛	..
100,000	*Dist. E.L.Co.*) 4½% 1st Deb. Stock	100	..	..	..	105 —109	106 —110	109	107
80,000	Urban Electric Supply, Ord.	5	..	..	..	4¼— 5	4⅜— 5	4⅜	..
80,000	Do. do. 5 % Cum. Pref	5	..	..	..	4¼— 5	4⅜— 5	4⅜	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	..	100 —102	101 —103	101½	100⅜
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12⅜— 13⅜	12⅜— 13⅜	13⅜	12⅛
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6⅛— 6⅝	6⅛— 6⅝	6⅛	6⅛

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS Wednesday, October 26th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.		5/-	..
a ,, Nitric .. .. per cwt.		22/-	..
a ,, Oxalic .. .. per cwt.		32/-	..
a ,, Sulphuric .. .. .. per cwt.		5/6	..
*a Ammoniac, Sal .. .. .. per cwt.		42/-	..
a Ammonia, Muriate (crystal) .. per ton		£33 10	..
a ,, ,, ... per ton		£30	..
a Bleaching powder .. .. .. per ton		£5 5	15/- inc.
a Bisulphide of Carbon .. .. per ton		£15	..
a Borax .. .. per ton		£13	..
a Benzole (90 %) .. .. .. per gal.		7/-	..
a ,, (50/90 %) .. .. .. per gal.		5/6	..
a Copper Sulphate .. .. .. per ton		£20	£1 inc.
a Lead, Nitrate .. .. .. per ton		£25	..
a ,, White Sugar .. .. .. per ton		£31	..
a ,, Peroxide .. .. .. per ton		£27 10	..
a Methylated Spirit .. .. .. per gal.		2/6	..
a Naphtha, Solvent (90% a 160° C). per gal.		5/6	..
a Potash, Bichromate, in casks .. per lb.		8d.	..
a ,, Caustic (75/80%) .. .. per ton		£24	..
a Shellac .. .. per cwt.		230/-	20/- inc.
a Sulphate of Magnesia .. .. per ton		£4 10	..
a Sulphur, Sublimed Flowers .. per ton		£6 10	..
a ,, Recovered .. .. per ton		£5 10	..
a ,, Lump .. .. .. per ton		£5	..
a Soda, Caustic (white 70 %) .. per ton		£10 15	..
a ,, Crystals .. .. .. per ton		£3	..
a ,, Bichromate, casks .. .. per lb.		2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots .. per ton		£130	..
b ,, Wire, in ton lots .. per ton		£168	..
b ,, Sheet, in ton lots .. per ton		£166	..
b Babbitt's metal ingots .. .. per ton		£48 to £140	..
c Brass (rolled metal 2" to 1½', basis		per lb.	6¼d.	..
c ,, Tube (brazed) ..		per lb.	8¼d.	..
c ,, ,, (solid drawn) .. .. per lb.		7½d.	..
c ,, Wire, basis .. .. .. per lb.		7d.	..
c Copper Tubes (brazed) .. .. per lb.		9½d.	..
c ,, ,, (solid drawn) .. per lb.		9½d.	..
c Copper Bars (best selected .. per ton		£74	..

METALS, &c. (*continued*).

		Latest Price.	Week's Dec. or Inc.
g Copper Sheet .. .. .. per ton		£74	..
g ,, Rod .. .. per ton		£74	..
e ,, (Electrolytic) Bars .. per ton		£64	..
e ,, Sheets .. per ton		£80	..
e ,, ,, Rod .. per ton		£74	..
e ,, ,, H.C. Wire per lb.		8⅝d.	⅛d. inc.
f Ebonite Rod .. .. .. per lb.		8/8	..
f ,, Sheet .. .. .. per lb.		8/-	..
n German Silver Wire .. .. per lb.		1/6	..
h Gutta-percha fine .. .. .. per lb.		8/-	..
h India-rubber, Para fine .. .. per lb.		4/11	1d.—2d. dec.
i Iron, Charcoal Sheets .. .. per ton		£18	..
i ,, Pig (Cleveland warrants) per ton		44/-	1d. dec.
i ,, Forgings, according to size per ton		From £11	..
i ,, Scrap, heavy .. .. per ton		47/6 to 50/-	..
i ,, Wire, galvanised No. 8 .. per ton		£9 15	..
g Lead, English Ingot .. .. per ton		£12 12 6 to £12 15	2/6 to 5/- inc.
g ,, ,, Sheet .. .. per ton		£11 17s. 6d.	..
m Manganin Wire No. 28 .. .. per lb.		8/-	..
g Mercury .. .. per bot.		£7 15	..
d Mica (in original cases) small .. per lb.		6d. to 1/	..
d ,, ,, ,, medium per lb.		2/6 to 4/-	..
d ,, ,, ,, large .. per lb.		4/6 to 8/6	..
p Phosphor Bronze, plain castings per lb.		1/- to 1/2½	..
p ,, rolled bars & rods per lb.		1/- to 1/8	..
p ,, ,, strip & sheet per lb.		From 1/1	..
o Platinum .. .. per oz.		£4	..
e Silicium Bronze Wire .. .. per lb.		9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n per ton		£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block .. .. per ton		£132 to £133	£1 dec.
g ,, Foil .. .. per lb.		1/6	..
n ,, Wire, Nos. 1 to 16 .. .. per lb.		1/8	..
p White Anti-friction Metals— "White Ant" brand .. per ton		£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.		8d.	..
j ,, 6 lea. Flax .. .. .. per lb.		5½d.	..
j ,, 8 ply 10 lbs. Russian .. per lb.		4½d.	..
j ,, 10 lbs. Russian, single .. per lb.		4½d.	..
j ,, 180 lbs. Jute rove .. per ton		£11	..
k Zinc, Sh'ts (Vieill'e Montagne bnd) per ton		£26 7 6	12/6 inc.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.. *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	*	No. wks.	Total to date. £	*	Miles open.	*
Aberdeen	Oct. 15	1,254	+ 43	20	31,708	+ 5,626	10	—
Bath	,, 19	635	—	43	27,318	—	12½	—
Birmingham	,, 22	5,645	+453	44	231,603	+12,743	3½	—
Blackburn	,, 21	860	+ 45	30	29,261	+ 2,911	13½	—
Blackpool	,, 20	501	+ 91	29	40,262	+ 5,690	8½	—
,, —Fleetw'd	,, 22	278	+ 22	16	19,201	+ 225	7½	—
,, —Lytham	,, 20	226	— 11	51	20,269	+ 7,134	7½	—
Bolton	,, 23	1,815	+ 69	30	56,567	+ 475	25	—
Bournemouth ..	,, 19	945	+ 24	29	31,783	—	10½	—
Bradford	,, 15	4,437	+831	28	134,859	+23,767	53	—
Brighton	,, 23	901	+ 90	—	32,456	—	9	—
Bristol	,, 21	4,837	— 22	—	—	—	28	—
Devonport ..	,, 14	533	+ 45	41	22,243	+ 3,329	5	—
Dudley—Sto'rb'ge	,, 14	820	+ 21	41	36,298	+ 1,421	18½	—
Gateshead ..	,, 14	901	— 14	41	37,470	+ 1,451	10½	+ ½
Gr'n'k—Pt. Glsgw	,, 14	168	+ 9	41	24,049	+ 1,225	7½	—
Oldham—Ashton	,, 14	542	— 1	41	22,755	— 968	8	—
Potteries	,, 14	1,760	+ 58	41	70,323	+ 5,356	28½	—
South Staffs. ..	,, 14	927	—127	41	31,744	— 5,625	21½	—½
Swansea	,, 14	493	— 21	41	22,664	+ 997	5½	—
Wolverhampton ..	,, 14	373	— 10	41	16,228	— 50	10½	+8
Yorks. Wool Dist.	,, 14	533	+ 68	41	24,547	+ 8,849	6	—
Miscellaneous ..	,, 14	3,275	—	41	158,745	—	—	—
Burnley	,, 22	1,016	+194	—	—	—	10½	+½
Burton-on-Trent ..	,, 16	325	— 36	28½	10,471	—	8½	—
Cardiff	,, 15	1,922	— 40	28	60,040	+ 1,731	14	—
Chatham & District	,, 20	586	+ 37	42	25,108	+ 2,186	9·68	—
Cork	,, 20	477	— 28	42	19,983	— 2,504	9·89	—
Dover	,, 23	198	+ 13	42	9,415	— 294	8	—

* Compared with the corresponding period of 1903.

Locality.	Week ending	Receipts for the week. £	*	No. wks.	Total to date. £	*	Miles open.	*
Dublin	Oct. 21	4,719	+112	—	86,651	— 3,320	47	+ ½
East Ham	,, 22	654	+ 26	29	22,283	+ 1,495	6½	—
Glasgow	,, 23	14,922	+1024	21	301,397	+17,067	71½	+5½
Halifax (2 weeks) ..	,, 19	2,636	+100	29	45,642	+ 3,516	33	+1½
Huddersfield ..	,, 22	1,253	+ 28	29	41,457	+ 2,786	28	—
Hull	,, 22	2,167	+284	29	64,955	+ 8,678	13	+2
Ilkeston	,, 19	126	— 19	29	4,826	—	3·5	—
Ipswich	,, 22	415	—	29	15,582	—	10½	—
Isle of Thanet ..	,, 22	377	+ 19	42	32,169	+ 1,647	10½	
Leeds	,, 22	5,480	+280	29	178,493	+10,698	89	+9½
Liverpool	,, 15	10,533	+291	42	486,780	+12,640	108	—
London C. C. ..	,, 15	13,145	+3561	28	365,492	+76,542	47½	+7½
Manchester	,, 22	12,241	+741	29	364,316	+15,419	137½	+12½
Newcastle	,, 22	3,721	+ 75	—	—	—	17	—
Portsmouth	,, 15	1,740	+267	—	61,409	+ 5,116	14½	—
Salford	,, 17	4,008	+ 35	29	119,091	+ 7,526	30	—
Sheffield	,, 23	4,689	+196	30	142,528	+ 2,865	34½	+1½
Southampton ..	,, 20	917	— 49	29	30,128	— 2,001	16½	—
Southend-on-Sea ..	,, 19	272	+ 29	29	12,176	+ 1,292	6½	—
Sunderland	,, 23	1,288	+150	29	39,023	+ 643	21	+1
Tyneside	,, 19	477	+159	42	16,694	+ 2,845	8·9	+·4
West Ham	,, 20	1,060	—	34	31,582	—	9·78	—
Wolverhampton ..	,, 19	787	+351	—	—	—	9·5	—
Cen. London Rly. ..	,, 22	6,699	— 38	16	97,250	— 282	6	—
City & S. Lon. Rly.	,, 23	2,806	—140	17	41,552	— 1,477	6½	—
Dublin—Lucan Rly.	,, 21	109	— 7	16	2,254	— 27	6½	—
G. N. and City Ry.	,, 22	1,218	—	36	35,348	—	3½	—
L'pool Overh'd Rly.	,, 23	1,495	—137	17	27,564	— 1,901	6½	+4½
Mersey Railway ..	,, 22	1,454	+170	16	23,285	+ 1,902	4½	—

ELECTRICAL LAW IN THE COLONIES AND INDIA.

[FROM OUR LEGAL CONTRIBUTOR.]

(*Continued from page* 634.)

THE promoters are given power, by Sec. 18, to make bye-laws with regard to (*b*) the charges to be made to persons requiring to be supplied with electric current; (*c*) the interference with, or obstruction by, any person of any of the works authorised by the Act, while by Sec. 26 the Governor in Council may from time to time make regulations in accordance with the regulations for the time being of the Board of Trade of the United Kingdom, for securing the safety of the public from personal injury, or from fire or otherwise, and for minimising as far as may be reasonable, any interference with the electric wires, lines, &c., of the Government.

The promoters are also under heavy responsibility to prevent their works occasioning any damage to anybody.

Sec. 33 of this Act, which related to compulsory purchase, was repealed by Act No. 24, of 1903, Sec. 3 of which provides that:—"The Governor in Council, or any municipal corporation, local board, or other local authority, which may hereafter have jurisdiction over the lands served by the said tramway, shall be empowered, subject to the approval of Parliament, at any time, after the expiry of 21 years from the date of this Act coming into force, and after giving not less than six months' notice, to purchase and take the whole of the works authorised by this Act, and the promoters shall be required to sell, transfer, and hand over to the Colonial Government, or any such corporation, board, or authority, the works so purchased, and the purchase price shall be paid to the promoters."

Any such purchase shall be effected according to the provisions of the Law No. 16 of 1872.* Provided

Thus Sec. 25 provides that "The promoters shall be answerable for all accidents, damages, and injuries happening through their act or default, or through the act or default of any person in their employment, by reason or in consequence of their works, cars or carriages, and for all damage done by electrolysis or otherwise, resulting from electric leakage, and shall save harmless all road and other authorities, companies, or bodies, collectively or individually, and their officers and servants from all damages and costs in respect of such damages, accidents and injuries."

Sec. 27 provides that "The promoters, subject to the acquisition of certain rights from the Government, shall have the right to purchase or take such lands as may be necessary for the purposes of (*inter alia*) carrying out and completion of any works under and by virtue of the powers and privileges granted to them by this Act. Provided that if the taking of any such lands shall cause damage to any person or his property, such person shall be entitled to compensation or recompense, to be settled in case of difference as if the claim constituted damage to land within the meaning of Sec. 65 of the Lands Clauses Consolidation Law.

"(*a*) That the purchase price shall be determined according to the value of the works at the time of purchase, without any addition in respect of compulsory purchase, statutory rights, goodwill, or profits, save as is provided in sub-section (*b*); and

"(*b*) That there shall be added to the value ascertained as aforesaid an amount as interest, equal to 10 per cent. on the value ascertained as aforesaid."

Sec. 34 provides that "Nothing in this Act shall be deemed to create a monopoly in favour of the promoters."

In 1903 the Natal Legislature passed another Act (No. 23 of 1903), entitled the "Sydenham Tramways, Lighting, and Electric Current Supply Act." To all intents and purposes it is the same as the measure which we have just considered. There is one clause, however, to which attention should be drawn, namely, that which relates to injury to ocean cable or landline subsidised by Government. It is there provided that:—

"If any ocean cable or the landlines connected therewith subsidised by the Government of Natal, is at any time in any way injuriously affected by the construction by the promoters of their electric lines and works, or by the working of the undertaking of the promoters, the promoters shall pay the expenses of all such alterations in or additions to such cable and landlines as may be necessary to remedy such injurious affection. For the purpose of this section, a cable or landline subsidised by the Natal Government shall be deemed to be injuriously affected by an act or work if telegraphic communication by means of such cable is, whether through induction or otherwise, in any manner affected by an act or work, or by any use made of such work."

The introduction of the above clause is interesting, and probably came about in consequence of the decision of the Judicial Committee of the Privy Council in the case of Eastern and South African Telegraph Co., Ltd. *v.* Cape Town Tramways Co.'s, Ltd. [(1902) A.C. 381]. It will be remembered that in that case the plaintiff company brought an action against the tramway company for disturbances in the working of their submarine cable caused by an escape of electricity stored by the respondents for the due working of their tramway system. It was decided in regard to that section of the tramway which had not been constructed under statutory authority, the principle of Fletcher *v.* Rylands (which imposes upon a man the duty of keeping anything dangerous on his own land in safe custody) did not apply in its entirety, because the disturbances only resulted when the cable was constructed without certain precautions which the evidence showed had subsequently secured its immunity.

It is probable that the Natal Act above mentioned was passed with the express object of neutralising the effect of this decision, which would be considered binding upon all Colonial courts in the British Empire.

X. *New Zealand.*—In 1884 an Act was passed by the New Zealand Legislature, entitled "An Act to consolidate and amend the laws relating to the construction, maintenance and protection of electric lines for purposes of communication or for other purposes, and to provide for the regulation thereof." Although this measure was primarily intended to provide for the erection and maintenance of telephone and telegraph wires, nevertheless it contains a series of provisions with regard to electric lighting.

Sec. 47 provides that the Governor may from time to time construct and maintain electric lines for lighting purposes in or connected with public offices or buildings under the control of the Governor in any part of the Colony. By Sec. 48:—"Any local authority having power by law to construct public works within the district under its jurisdiction may construct and maintain electric lines for lighting purposes within such district as a public work, in like manner and with the like powers, authorities and liabilities as may by law be exercised in respect of, or as are attached to, the construction of such public works, but subject to the provisions of this part of this Act." Sec. 50 provides that electric lines for lighting purposes must not be erected across other lines without license.

Sec. 51 provides that the commissioner (*i.e.*, the Electric Telegraph Commissioner appointed under the Act) or any officer of his department appointed by him from time to time for that purpose by a notification in the *Gazette*, may grant and issue licenses in any case where the applicant desires to lay, or put up, or erect and maintain, an electric line for lighting purposes; or where an electric line for lighting purposes has already been erected, and the applicant desires to continue and maintain the same, subject as follows:—

1. All licenses shall be in writing in such form as the commissioner may from time to time prescribe.

2. Any such license may be extended to any other locality than that mentioned therein by the commissioner on the request of the applicant, and any such license may be transferred by the holder to any other person by an endorsement signed by the licensee.

3. Licenses may be revoked by the commissioner if the holder is convicted of any offence against this part of the Act, as, for instance, if he commits a breach of the regulations which (by Sec. 52) may be made from time to time by the Governor in Council for the public safety. Such regulations as from the date thereof have the like effect in every

* A law which corresponds to the Lands Clauses Consolidation Acts.

respect as though they had been originally inserted in every license granted under the Act.

Sec. 54 is perhaps the most important of all, as it limits the right of supplying electricity for public purposes. It provides that "Except in respect of lines constructed by the Governor, or a local authority as aforesaid, no person shall lay, construct, put up, or place any electric line for lighting purposes as an undertaking of a public nature, except under the authority of a special Act of the General Assembly."

"But this provision shall not extend to any case where the electric line used or intended to be used is not laid, conveyed, or placed, or intended to be laid, conveyed, or placed, beyond the limits of the building or premises in which the electricity is generated for such lighting purposes."

By Sec. 335 of the Municipal Corporations Act, 1900, it is provided that subject to conforming to the provisions of the above measure, the Council of a borough as constituted under the Act may do all things necessary to light the streets and public places of the borough with electricity, and may supply electricity to the inhabitants.

An Act was passed in 1896 (60 V. c. 47) which provided that "Notwithstanding anything to the contrary contained in any other Act, it is hereby declared that from and after the coming into operation of this Act, it shall not be lawful for any local authority to grant to any person any right or concession for the purpose of either generating or using electricity as a motive power, without in each instance the previous consent of the Governor by Order in Council gazetted."

Acts appear to be passed from time to time in New Zealand for the purpose of giving county or municipal authorities power to contract with companies for the supply of electricity. Such Acts appear to recognise the principle of compulsory purchase. Thus by the Ohinemuri County Electric Power and Lighting Act (No. 18) of 1899, the chairman, councillors, &c., of the County of Ohinemuri were authorised to enter into a contract of this kind. By Sec. 2 of the Act it is provided that there shall be a Board of Control for the purposes of the Act, consisting of the Governor in Council. This Board of Control may make rules and regulations for the control of any persons contracting with the county authority in the interests of the public safety, and may from time to time alter and amend such regulations. By Sec. 4, subject to the Electric Lines Act (1884) (*ubi supra*), and certain other Acts, the county authority "may contract with any persons or company for the construction, maintenance, and working of an electrical installation for supplying electrical energy for public and private purposes within the said county, and may for such purpose grant "all the necessary powers for breaking up or otherwise interfering with roads or highways," upon such terms and conditions and for such period not exceeding 42 years, and subject to such regulations and provisions as may be agreed upon between the contracting parties. After the agreement is drawn up, it is provided, by the fifth Section that there must be a submission of the question whether it shall be entered into or not, to a poll of the ratepayers.

Sec. 7 provides that, in any such contract, there shall be an express provision entitling the county authority "at the expiration of the term mentioned therein, or earlier, if the parties to the said contract shall think fit, to purchase the installation and works erected in pursuance thereof at a price, in case the said County Council and other contracting party shall not agree, to be ascertained by arbitration in the manner provided by the contract." Then follow the significant words:—"In no case shall the county authority contract to pay, or pay, nor shall there be included in the price to be ascertained as aforesaid any sum for goodwill. And any contract or undertaking on the part of the Chairman, Councillors, and inhabitants of the Ohinemuri County contrary to the last-mentioned provision shall be null and void to all intents and purposes whatsoever."

(To be concluded.)

Scunthorpe Lighting.—The U.D.C. has resolved to apply to the L.G.B. for sanction to borrow £4,500 under its E.L. order, this decision being arrived at with a view to "keeping other people out."

THE FIFTH INTERNATIONAL ELECTRICAL CONGRESS.

By R. BORLASE MATTHEWS, WH. EX.

(Continued from page 607.)

Continuing the discussion on Dr. Wolff's paper (of which an abstract is given on pp. 724—726 of this issue), Prof. Webster pointed out that from a theoretical point of view, one in 1,000 parts is the difference between the units in various countries, so he did not think that at the present time it would be advisable to change the laws, but rather to wait until some further investigations had come to completion that were being carried on by the scientific research laboratories in various countries at the present moment. He was in favour of units being defined by definition, for three standard instruments could not be passed around from country to country as well or as accurately as definitions. He thought that within the next five or 10 years, another figure would be obtained in the determination of both the ampere and the volt, though at the same time he thought that it was not at all probable that a more correct determination of the ohm would be made for at least another 25 years.

Prof. Carhart said that it would be useful to discuss this question not with the idea of making revolutionary changes, but rather with a view to obtaining greater uniformity. Cells could now be made with greater uniformity and consistency than ever before, and better results were obtained from their use as a standard than from the silver voltameter. The old difficulty with the cells was due to the impurities in the mercurous sulphate. In some experiments that he had carried out with the cadmium amalgam used in the Weston cells, he had found that this material could be contaminated by as much as $\frac{1}{100}$th part of zinc without producing any appreciable effect on the result, zinc being the impurity that was most objectionable.

As to which of the two fundamental units should be used, he was of the opinion that if they wished to have concrete standards, it was much easier to get them from an E.M.F. which could be obtained directly, rather than from current which could only be maintained indirectly. He pointed out that the silver voltameter was only a coulomb-meter, and the difficulty in maintaining an absolutely constant current was very great. Also the chemical equivalent of silver was not known within a near enough approximation. The potentiometer and standard resistances were used by everyone for the sake of the wide range available, so that evidently people would use a standard cell whatever the legal definition might lay down as the method of obtaining the true standard. This fact evidently pointed out the advantage of using a cell as a primary standard.

Mr. H. E. Harrison then referred to the "4π difficulty." He thought that very little trouble arose from the C.G.S. units, so that they should still be retained. He would like to see the nomenclature put on a better basis, and certain of the units brought into accordance with the suggestions put forward at the meeting of the Congress at the Paris Exhibition.

Dr. A. E. Kennelly, in discussing the subject, said that in his mind there were two distinct questions, questions that should be kept separate from each other—(1) the volt question; (2) the general unit question. He pointed out that, in America, the Clark cell was taken as giving 1·434 volts, but it was admitted that a closer approximation was 1·433 at standard temperature, and this was the figure adopted in Europe. That was to say, the American value differed from that of other nations by one-tenth of 1 per cent. He suggested that the recommendation made at the Chicago Congress, of accepting 1·434 as the voltage of the Clark cell, should be abolished by substituting the Weston cell, or, if this could not be done, let them change the 1·434 to 1·433, which more nearly approached the international method.

That the volt standard should be changed for the ampere standard was a much more serious question. The great difficulty, of course, was the existing laws of various countries. He thought it was best to leave well alone at present, and not upheave all standards for the sake of a "4π" by changing from an irrational to a rational system. The C.G.S. units should be kept in conformity with the consensus of

work in other branches of science, such as heat, chemistry, &c. It was too late now to alter the C.G.S. system, though they were hampered in carrying out work with artificial units in consequence of this system, the derived units being the only ones that were practicable.

Prof. J. Perry, in a characteristic speech, said that there ought to be as few fundamental units as possible, and asked whether they could not all be based on the C.G.S. system, all others being derived from this basis. Prof. Carhart's arguments seemed to him to be based on the idea that they must base the ampere, volt, and ohm on concrete examples. They should face the difficulty of dispensing with the awkward factor "4π" now. "If we do not, we shall be blamed by the people of 100 years hence."

With reference to the nomenclature, he did not think that any names were needed for these C.G.S. units; everyone knew that they were in C.G.S. units; why, therefore, should they be named?

With reference to the determination of the value of Clark's cell, Dr. Glazebrook mentioned that just before he left England, Mr. Trotter had given him a note of some experiments he had just completed, in which he passed a current through his standard ammeter (calibrated by a silver voltameter) and his standard ohm, obtaining the result of 1·4329. This, therefore, was the latest determination of the value of that cell.

Prof. G. W. Patterson pointed out that in the controversy of standard cell *versus* silver voltameter, the cell had a theoretical as well as a practical advantage, for the resistance had been absolutely determined. The question of time did not enter into the calibration of the cell, whilst it was a very important factor in the case of the silver voltameter. Of course, this took into account the assumption that the ohm had been accurately determined, and at the present there did not seem to be any likelihood of a better value being obtained.

Mr. Sharp and Mr. Duddell also took part in the discussion.

In the evening Dr. H. Goldschmidt gave a lecture in the Administration Buildings of the Exhibition, on Alumino-Thermics. The lecture, which was very interesting, was illustrated by lantern slides and experiments.

On Wednesday, September 14th, another joint meeting of the American and British Institutions of Electrical Engineers was held in the Festival Hall, in the grounds of the Exhibition, when the subject of "Different Methods and Systems of Using Alternating Current in Electric Railway Motors" was discussed. As this was Institute Day, Mr. B. J. Arnold opened with a presidential address bearing upon this subject. In the course of this address, he referred to the changes which had taken place since the Chicago Exhibition, when the difficulty was to prove to capitalists and financiers the superior advantages of electric over horse and cable traction. The interval had been one of great progress, which had been largely assisted by the introduction of the rotary converter system of operation on urban railways. Electricity now held the field without dispute for street railways and suburban lines, but it had not yet been proved that it was suitable for the trunk lines, and it did not follow that it would be suitable for these lines as worked under present conditions. Under special conditions, electric traction was beginning to make headway. At the terminals of some of the big railroad systems—for example, the New York Central Railway and the Pennsylvania Railway, where they were spending $70,000,000 at their new New York terminal stations on electric traction, showing that in the opinion of the engineers of these lines the electric locomotives could be made to meet the demands for quick and rapid handling of a large number of trains. Under present conditions, all railways working 500-ton trains required engines capable of exerting at least 1,000 H.P. Now taking capital investments into account, power could not be transmitted by electricity for this class of work as economically as was the case with the steam locomotive, so that electricity could not be adopted unless other conditions intervened, such as density of service, &c. Where four or more tracks could be laid down, and kept respectively for express and local, passenger and freight trains, electricity as a means of transmitting power would undoubtedly be the best, but at the positions where this would be most required, land would probably be much too expensive to allow of its being done. After analysing the question very carefully, he had decided that no general formulæ could be decided upon, but each case must be decided upon its merits. The only thing that was certain was that unless the number of trains was great enough it would not pay to electrify. In his opinion, electrification would come about gradually. At first the terminals would be equipped, either voluntarily or under the pressure of public opinion: for the acquirement of local electric lines by the big railway corporations, would lead to the public demand for the speedier, cleaner, and more comfortable electric service, thus causing the conversion of further parts of the trunk lines to electricity beyond the terminals. Speaking from a technical point of view, the principal problem before electric railway engineers was the use of a high-tension alternating-current system under safe conditions. There were great possibilities in the single-phase motor, which required only one live conductor. Wonderful progress had been made with this of late years especially in the last 12 months, and when it was remembered that the rotary converter only became of importance in 1898, the possibilities of a single-phase motor, considering the short time it had been experimented with, were endless. With the introduction of the steam turbine and the single-phase commutating motor, the cost of transmission had been reduced below the lowest figure they had been able to attain before, and they might hope for additional improvements which would bring about a further reduction. The steam locomotive would hold its own for many years to come, but undoubtedly there would be an enormous progress in electric railroad enterprise, working in conjunction with the steam roads. $4,000,000,000 of investments in electric enterprises would undoubtedly give impetus to this great branch of engineering.

Dr. Steinmetz opened the discussion with a magnificent and comprehensive speech, in the course of which he stated that this was not by any means a new subject, though very little progress had been made for some years for many reasons. The alternate current polyphase induction motor came into the foreground in stationary work, showing its superiority over all others. It was only natural, therefore, that it should have been experimented with for railway purposes, the trials being continued until the introduction of the rotary converter, which, while having the advantage of only requiring one overhead live conductor, also had other qualifications which were greatly in its favour, such as the absence of armature reaction, superior regulation, and the ability to carry overloads which no direct current generator could undertake.

In the past year the limits of the practicability of the rotary converter had been approached, for this type of machine could only be used where the density of traffic was sufficiently great, the expense of maintaining sub-stations being otherwise too high at the comparatively short intervals at which these stations should be placed for economical operation. Some other system must therefore be brought forward to fulfil this new requirement. Dr. Steinmetz then said that personally he did not believe that the alternate current motor would make any serious inroads into the present direct current field, but rather that it would find a field of its own and develop along a new line, just as in electric lighting direct-current was not likely to be entirely superseded by alternate current. The alternate current motor would, without doubt, open out a way for itself that the direct-current machine could not follow.

(*To be continued.*)

AUTOMATIC CENTRAL STATION APPLIANCES.

Central station engineers are at present possessed by a craze for automatic machinery. It is hard to say whether this trend of thought is permanent, but if it is only temporary the point at which reaction commences has not yet been reached, provided that the equipment of recent large power houses may be taken as an indication. The enclosed automatically-lubricated engine competes with the older open-type engine, and in its turn is being rivalled by the

steam turbine. We have automatic stokers, automatic weighing machines, coal conveyers, automatically controlled boosters and other pressure-regulators, automatic and motor-driven switches and cut-outs, and automatic alarms for every conceivable purpose. In polyphase work the induction motor is preferred to the synchronous type, in spite of its lagging currents and consequent heat losses in windings and cables, because the switching operations approximate to automaticity, while futile attempts have even been made to automatically parallel synchronous generators and motors. The contrast between the simple manually-operated stations of 10 years ago and the aggregations of automatic devices which now do service is too noticeable to require further emphasis.

The object is, of course, to cut down the wages bill as much as possible. This item presented itself as such a large proportion of the station costs, in the days when the consumption of electricity per station was not so great as it now is, that station engineers eagerly sought means to reduce it. Many examples of automatic machinery—as, for example, enclosed engines—require little skilled attention for the first few years of their run. The immediate effect of their introduction was therefore the reduction of the cost of station staff without a corresponding increase in the maintenance account, A time-lag was in effect put on the cost of running, which was met in an entirely empirical manner by putting a proportion of revenue aside for depreciation. The vogue of automatic machinery, once established, has persisted until it is now taken as an axiom that plant which will perform automatically that work which was before done by hand is of necessity an advantageous machine.

There is no intention in this article to dogmatise, but to ask whether, under the new conditions of supplying power in bulk from single large stations, when such immense interests are involved, and where station costs will in any case be in less proportion to the total costs of running than formerly, owing to the large power units used, it is not wise to consider the whole question *de novo?* In other words, are we not introducing into our large power stations risks which were necessary in order to make small and inefficient generating stations pay their way, but which can now be eliminated ?

The two chief elements of reliability in machinery are simplicity of operation and facility for continuous inspection. An automatic machine which, in doing work which was formerly manual, introduces complication of process or of construction, is to be regarded with suspicion. For example, if in attempting to do away with manual coal-handling, a succession of elevators, scrapers, buckets and what not has to be carried through devious paths from level to level, that arrangement is no longer truly automatic, for, in addition to the man who switches the motor on and off (who may quite properly be an unskilled labourer), a fitter is constantly required to make adjustments and keep the gear from wrecking itself. Again, concentration of switchboard control at one point has, in some cases of large power stations, been carried so far as to operate main switches by motors which in their turn are started, stopped and reversed by auxiliary circuits whose switchgear is concentrated at one point. The value of having the whole of the switchgear under the control of one man is undoubted. The question is whether the complication of the process does not give cause for anxiety as to one link in the chain failing at some crucial moment.

The other point referred to—ease of continuous inspection—is of equal importance. It is an experimental fact that man, particularly the working man, works paradoxically. Give him plenty to do—enough to put a strain on him while he is at work—and provided that he is in good health and spirits, he will respond to the strain and exercise tireless vigilance. Do his work for him—only require him to go round four times an hour to see that his automatic machinery is going properly—and the spasmodic nature of his work will cause him to be less and less inclined to make the periodic effort of starting, so that the plant will really receive less attention than before. Hence the men in attendance of the plant must be cut down to that number whose time will be fully occupied in inspecting the automatic machinery. This apparent economy is, however, introducing serious risks. Suppose that any part of the automatic plant breaks down. The function of the station staff is now to get it right, and, in addition, to control the rest of the plant. A heavy strain is thus suddenly thrown on the operators which they are oftentimes unable to meet. Many a station engineer can recall ruefully the occasion when his automatic plant broke down. Added to this is the fact that much of the automatic machinery on the market is so efficiently boxed-in that periodic inspection is of necessity only superficial. In an open-type engine the driver goes round continuously, feeling bearings and watching his oil-feeds. In an enclosed engine the first indication of anything wrong is bad governing, a steam-hammer performance, and clouds of oily smoke. Generally speaking, the introduction of automatic machinery will, sooner or later, involve a large fitting staff, though it may reduce the number of operators. For if a fault is not soon detected, the damage done usually increases at a very much higher rate than the lapse of time. And to ensure early detection, continuous detailed inspection is essential.

Leaving out of account the question of the reliability, it is even questionable whether, in many cases, money is saved by the introduction of self-operating plant. The increase of the repairs account has already been mentioned. Where automatic machinery consumes power for its operation, the cost of such power must be charged against it just as much as against an outside consumer, in order to get a fair comparison. The proportion of interest and sinking fund on the capital laid out on automatic gear must also be taken into account. As against this is the cost of manual labour. Especially at present, labour is so cheap, and so willing to submit to onerous conditions, that it seems like travailing without cause to replace it by automatons.

If a general summing up can be made on a question the solution to which must largely depend on local conditions, it would seem that, where automatic machinery gives more efficient control, more ease of manipulation, more all-round economy, and as much reliability as manual labour, it may be advantageously used. Where any of these points are questionable, the value of such machinery must not be implicitly assumed.

THE SO-CALLED INTERNATIONAL ELECTRICAL UNITS.

Abstract of Paper by Dr. F. A. Wolff, read at a joint meeting of the British and American Institutions of Electrical Engineers at the St. Louis International Electric Congress, on Tuesday, September 13th, 1904.

This paper was divided into two parts, the first summarising the history of the definition of the fundamental units; this commenced with an account of the work of Jacobi in 1848, successively followed by the proposals of Werner von Siemens in 1860, the British Association's first Committee of 1861, the International Congresses held at Paris in 1881, 1889, and 1900; at Frankfort in 1891; and at Chicago in 1893; also of the committees appointed by the British Board of Trade, and the American Institute of Electrical Engineers. This showed how the need of a definite and universal system of electrical units was early recognised, and became a necessity as more and more industrial applications of electricity were made.

The increased accuracy obtained by the use of apparatus of improved construction, and by refinements in the methods employed, led to a much closer agreement of the various re-determinations of the absolute electrical units, and their relation to the Siemens unit, the Clark cell, and the electro-chemical equivalent of silver, in terms of which many measurements were made. Thus the definitions have had to be reconsidered from time to time as mentioned above, and new drafts and specifications made.

Notwithstanding that the resolutions of the Congress held at Chicago were adopted with practical unanimity, and might, therefore, have been considered as in a sense binding on the various governments, only the Governments of the United States, Great Britain, Canada, Germany, Austria, and France have legislated on this subject, and only a few of these have acted strictly in accordance with the resolutions of the Chicago Congress.

In the second part of the paper the Legalisation of the Electrical Units by the various governments was dealt with.

No two countries have defined the electrical units in the same way, probably owing to the insufficiency of the Chicago definitions for the following reasons:—

1. It is evident that all three of the units should not be defined in terms of concrete standards, connected as they are by Ohm's law, so that only two of the three are independent, and hence the third should be defined in terms of the other two.

2. The two units adopted as fundamental should be defined only in terms of concrete standards, and not in terms of the absolute units.

3. The specifications for the silver voltameter were shown to be entirely inadequate.

4. Redeterminations of the electromotive force of the Clark cell at 15° C. in absolute measure indicated that this value was nearer 1·433 volts than 1·434 volts.

The Unit of Resistance.

Taking the fundamental units in turn, it will be found that the unit of resistance legalised by the United States, Germany, France and Canada, and the definitions in the proposed Belgian and Swiss laws, are essentially the same as those adopted at Chicago, differing only in that no reference is made to the unit of resistance being based on 10^9 C.G.S. units in case of the German and French laws, and in the proposed Swiss and Belgian laws.

In England the ohm is defined both as having the value of 10^9 in terms of the centimetre and the second of time, and as being represented by "the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14·4521 grammes in mass of a constant cross-sectional area and of a length of 106·3 cms." In addition, a distinction is made between the unit of resistance and the standard of resistance, and for the latter purpose a particular platinum-silver coil, preserved at the Board of Trade Electrical Standardising Laboratory in London, and adjusted to represent the unit on an assumed relation between the standards of the British Association and the mercurial unit, is legalised.

It will thus be seen that the unit of resistance has been defined:—

1. In terms of the absolute C.G.S. unit.
2. In terms of the mercurial column.
3. In terms of the resistance of a particular coil.
4. In terms of combinations of the above.

The objections to the first method are that while the unit is theoretically fixed, resort must in practice be had to material standards, in the absolute measurement of which errors amounting to at least 0·01 per cent. are introduced. Another objection to this method lies in the limited range within which accurate measurements of resistance may be made with a given apparatus, so that in practice the measurements would have to be referred to material standards, the constancy of which might from time to time be checked to within the above stated limit of accuracy.

Profs. W. E. Ayrton and A. V. Jones suggested that the unit of resistance be defined in terms of a particular Lorenz apparatus preserved in a National Physical Laboratory; but even then an uncertainty of at least 0·01 per cent. would remain, if this practice were adopted by a single government, whereas its general introduction would certainly introduce greater differences.

The accuracy with which resistance comparisons can be made has for a long time far exceeded the above limits, and the need of an accurate standard, reproducible at any time and at any place to a higher degree of accuracy, has been recognised, as this would enable measurements the world over to be expressed in terms of the same unit—a result of much greater importance than in absolute measure, with its limited accuracy. In the definition of the concrete standard, it is only necessary to assume for it a value in accordance with the best absolute measurements. This once done, with a sufficient approximation for practical purposes, the definition of the concrete standard need not be modified.

It has, therefore, been generally recognised that reproducibility should be the first requirement for any international standard, and this qualification is fulfilled to an eminent degree by the mercurial unit, as defined by the Chicago Congress.

There is, however, one criticism which might still be made of the definition of the unit of resistance in terms of the mercurial unit, and that is that some form of terminal must be applied to the tube to connect it to the circuit containing the resistance standard with which it is to be compared, for which it is difficult to correct. This source of uncertainty could be eliminated by specifying the approximate cross-section or length of the tube representing the unit, the nature of the terminals, and the magnitude of the correction factor to be applied.

The Unit of Current.

The Chicago definition of the ampere as one-tenth of the C.G.S. unit has been followed almost verbatim by the United States, Canada, France and Austria.

In Germany and Switzerland the ampere is simply defined in terms of the electro-chemical equivalent of silver.

In England it is defined both as one-tenth of a C.G.S. unit and as being represented by "the unvarying electric current which, when passed through a solution of nitrate of silver in water in accordance with the specification appended hereto, and marked A, deposits silver at the rate of 0·001118 of a gramme per second." In addition, a distinction is made between the unit of current and the standard of current, the latter being defined in terms of a particular standard ampere balance preserved in the Board of Trade Electrical Standardising Laboratory. Thus the ampere is defined in three distinct ways, and in some cases the same country has defined it in two or more ways.

The two arguments most frequently advanced in favour of concretely defining the ampere, instead of the volt, are as follows:—

1. According to Faraday's laws of electrolysis, the amount of a given metal deposited in a given time by a given current is constant; but, while Faraday's laws may be fundamental laws of nature, complications are introduced by secondary reactions at the electrodes, which vary with the metal and the current density employed. Constant results are, however, obtainable by specifying the form and manner of employment of the voltameter at least in the case of the silver voltameter.

2. Current intensity can be determined in absolute measure directly by the electro-dynamometer, while electromotive force can only be measured directly in absolute units of the electrostatic system, and the accuracy with which the results can be reduced to electro-magnetic units depends upon the accuracy with which "v," the ratio of the units of the two systems or the velocity of light, is known, and this is uncertain by possibly as much as 1 part in 1,000.

The objections which might be urged against defining the ampere, instead of the volt, are as follows:—

1. With a given silver voltameter the range is limited, and only currents lying within certain narrow limits can be accurately measured.

2. Enough time must be allowed for the deposit of at least several grammes of silver so that accurate weighings may be made.

3. The duration of the experiment must be at least one-half hour, in order that the time may be accurately measured.

4. During the experiment the current must be kept constant by continuous regulation, or the variations from its mean value must be determined at frequent intervals, so that the average value may be calculated.

5. Tedious double weighings must be made to determine the amount of silver deposited.

6. The result finally obtained applies to the average value of the current employed during the experiment, and cannot be utilised for the accurate measurement of other currents except by reference to a standard cell and a standard resistance, or to some form of apparatus for current measurement, such as the electro-dynamometer, in which case the accuracy is not as great as that obtained by direct reference to a standard cell.

Unit of Electromotive Force.

The definition of the volt adopted at Chicago has been legalised almost verbatim by the United States, Canada and France. In Germany and Austria it is defined simply in terms of the ohm and ampere, as is also the case in the proposed Swiss and Belgian laws.

In England the volt is defined as 10^8 C.G.S. units, in terms of the ohm and ampere, and in terms of the Clark cell. In addition, a distinction is made between the unit of electromotive force and the standard of electromotive force, the latter being defined as the $\frac{1}{100}$th part of the pressure producing a certain deflection of a Kelvin electrostatic voltmeter of the multi-cellular type preserved at the Electrical Standardising Laboratory of the Board of Trade.

Here again the definitions legalised differ considerably. Of the various definitions only two need be considered—that in terms of the ohm and ampere, if these units are taken as fundamental, and the definition in terms of the standard cell, if the ohm and volt are taken as the fundamental units.

The arguments in favour of the latter alternative may be briefly summarised as follows:—

1. The facility with which any voltage may be directly measured in terms of the standard cell by the potentiometer.

2. The accuracy with which such measurement may be made, which is practically limited only by the accuracy with which resistance is measurable and by the reproducibility of the cell.

3. The accuracy with which the standard cell can be reproduced, which even to-day exceeds all practical requirements, and which may be still further increased by specifying more precisely the manner of purification and preparation of the materials employed, &c.

4. The resulting definition of the ampere in terms of the ohm and volt, which corresponds to the actual method employed in precision measurements of current intensity by the potentiometer method.

5. The facility and accuracy with which any current may be thus measured.

These considerations have led to the adoption of the Clark cell in Germany as the practical standard of electromotive force, the value of the E.M.F. being given as 1·4328.

In the United States the legalised value of the electromotive force of the Clark cell is 1·434 volts at 15°C.

Standard Cells.

Of the standard cells proposed, only the Clark and Weston cells are to be considered at present. In the former the electrodes consist of zinc amalgam covered with a layer of zinc sulphate crystals, and pure mercury in contact with a paste of mercurous sulphate, zinc sulphate crystals and metallic mercury, the electrolyte being a saturated aqueous solution of zinc sulphate and mercurous sulphate.

In the Weston cell the electrodes consist of cadmium amalgam covered with a layer of cadmium sulphate crystals, and pure mercury in contact with a paste of mercurous sulphate, cadmium sulphate crystals, and metallic mercury, the electrolyte being a concentrated aqueous solution of cadmium sulphate and mercurous sulphate.

The investigations thus far reported indicate that individual cells of either type, set up from materials obtained from various sources and at various times, agree with each other to within 0·0002 volt, while there is a slight advantage in favour of the Clark cell on account of its higher electromotive force. The constancy and reproducibility of both types have also been established by the constancy of the ratio between them.

While sharing with the Clark cell these most essential qualities, the Weston cell has a number of marked advantages, which are certain to cause it to displace the former in the laboratory.

The principal of these advantages are:—

1. A low temperature coefficient, so that errors due to temperature uncertainties are negligible.

2. Absence of hysteresis effects attending temperature variations,

owing to the relatively slight influence of temperature on the solubility of the cadmium sulphate.

3. The average life is longer, owing to the absence of any tendency of the cell to crack at the point where the terminal is fused on.

4. No gas, apparently, is formed.

Specifications for the Standard Cell.

If either the Clark or the Weston cell be adopted as the standard of electromotive force, the specifications will have to be to some extent redrawn if the highest accuracy of reproduction is sought, as the differences between individual cells set up with different materials at present far exceed the relative errors made in current and electromotive force measurements by the potentiometer method.

It is, therefore, very important, if the unit of electromotive force is defined in terms of the standard cell, to specify the manner in which this material is to be prepared, and to modify some of the specifications relating to its treatment.

Fortunately, the metals entering into the composition of Clark and Weston cells—mercury, zinc, and cadmium—are among the few which can be obtained by special methods so pure that the foreign metals in them do not exceed more than 0·001 per cent.

The principal source of variation of the standard cell has lately been shown to be differences in the electromotive properties of the mercurous sulphate. The "chemically pure" mercurous sulphate of commerce contains, besides nitrates, &c., basic mercurous sulphate, mercuric sulphate, basic mercuric sulphate, and possibly sulphites.

Besides new specifications for the ampere or volt in terms of the electro-chemical equivalent of silver, or the electromotive force of some particular standard cell, respectively, it will be necessary to adopt a new value for one of these constants. This may be based either on the absolute determinations already made, applying to the accepted values corrections determined by the modifications in the specifications which may be adopted and a correction in order to bring the unit into closer agreement with the absolute value upon which it is based, or by new absolute determinations.

Two determinations of the electromotive force of the Clark cell in absolute measure made by Kahle, at the Reichsanstalt, and by Carhart and Guthe, indicate that the value adopted by the Chicago Congress, 1·434 volts, is too large by about 1 millivolt; and in addition, several redeterminations of the mechanical equivalent of heat in electrical units give values for the latter which can only be brought into accord with the values determined by the direct mechanical methods if the electromotive force of the Clark cell be taken as 1·433. If this value be adopted for the Clark cell or the equivalent value for the Weston cell, the international units will be defined with a quite sufficient absolute accuracy, as the above value is most probably known to at least one part in 2,000, and as at the present time a much higher absolute accuracy can hardly be predicted. It seems, on the other hand, that the main question is to define the international units with the prime object of reproducibility to the highest order of accuracy, and it is hoped that in this an accuracy of a few parts in 100,000 will be realised.

Derived Units.

The units of capacity, inductance, power and energy, should be defined in terms of the definitions adopted for the fundamental units.

Since the joule and watt have been defined in terms of the C.G.S. units by some countries, the new units could be differentiated by the prefix "international," a distinction already used to some extent in distinguishing between the absolute units and the international electrical units.

Magnetic Units.

The only official action thus far taken in defining the magnetic units is that of the Paris Congress of 1900, by which the C.G.S. units of magnetic field intensity and magnetic flux were adopted, the names Gauss and Maxwell being assigned to them. The adoption of additional units of magnetomotive force and magnetic reluctance, and the definition of all the magnetic units in harmony with the practical system of electro-magnetic units, has to be considered.

All these units should be defined in terms of the fundamental international electrical units—the ohm volt and ampere—and any resulting ambiguity might be removed by designating the units thus defined as international magnetic units.

"PHŒNIX" PATENT ELECTRIC SENSITIVE DRILL.

A neat form of electrically-driven sensitive drill has been brought out by the Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury, Bradford; the accompanying illustration shows its general arrangement for fixing on a bench, while it is also supplied mounted on a cast-iron column if preferred.

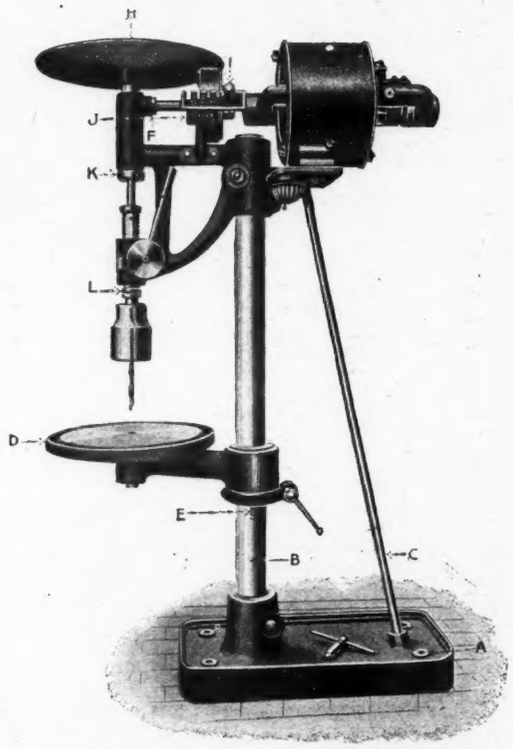
Referring to the figure, it will be seen that there is a massive base plate, A, to which are secured, by cotter pins, the column B and the stay C.

Upon the column, which is of bright, rolled steel, 2 in. in diameter, swivels the table D. The table is so arranged that a job clamped to it can be swung and operated on, in any direction within the range of the machine. The distance from face of column to centre of table is 10 in., the table itself being 12 in. diameter, and it has a recess cast round for oil, chips, &c.

The swivelling arm is carried by a split sleeve, which can be clamped in any position on the column; the latter is splined to guide the sleeve in a fixed position up and down the column; this also ensures the locating pin, E, correctly bringing the table centre to the centre of drill.

The headstock consists of a bracket, so designed that all stresses and strains, due to drilling, cannot disturb the alignment of the drilling spindle. This bracket is attached to the column by a taper key and nut, and is also bolted to the top end of the back stay.

Bolted to an extension of the bracket is a P.D.M. ½-H.P. two-pole motor, the speed being 1,200 r.p.m. The motor spindle is extended beyond one bearing, and supported at its extremity by a bronze bush, F, in the main frame. The spindle is splined, and carries a friction pulley which is free to slide across the friction plate, H. Attached to the friction pulley is a small lever, I, which can be placed in any one of the five notches on the plate below it. By dropping the lever into the notch corresponding to the size of drill in the chuck, the spindle instantly runs at the correct speed—two seconds will change from the highest to the lowest speed.



Phœnix Patent Sensitive Drill.

The friction plate is attached to a spindle, running in a long cast-iron bearing, in the vertical portion of the bracket. The spindle is fitted with an adjustable ball bearing, for putting grip on to the friction wheel, and all parts of this spindle are oiled from a lubricator, fitted on the top of the friction plate.

The feed motion consists of a rack on the sliding sleeve, into which gears a pinion, keyed to the feed lever. The lever itself fits in a taper hole, there being two positions provided.

The sliding sleeve has adjustment for wear by a knurled ring, K, and ball bearing, and is further fitted with a ball bearing, L, to take the thrust of the drill.

The machine can be fitted with any make of chuck to order, but the one sent with the standard machine is the Little Giant, No. O, holding to ½-in. drills. A switch is provided, fitted to the under part of the motor bracket, and within easy reach of the operator.

The motor, being series wound, and only taking from 1 to 2 amperes in normal use, needs no "starting switch" (as ordinarily understood), the on and off switch controlling it perfectly.

The machine is quite free from vibration, even at the highest drill speeds; it is guaranteed to drill ½-in. holes as fast as its operator can handle it, and some severe tests made upon it proved that it was impossible to pull the motor up; ½-in. holes were drilled in brass at the rate of over 3 in. per minute, and in boiler plate at 1½ in. to 2 in. per minute, while with a ¼-in. drill holes have been drilled at the rate of 7 in. to 8 in. per minute in brass.

All parts are interchangeable, and the motors fitted are of standard make, to suit any circuit (direct current) of from 100 to 230 volts (the standards being 100, 110, 200, 220 and 230 volts). The only connection required is an ordinary flexible cable. The makers are willing to send the machine on approval if desired.

SPAIN AND GOVERNMENT-OWNED CABLES.

On April 10th, 1904, the Director-General signed, and the Minister of the Interior approved, conditions of a tender for the maintenance and working of submarine cables already existing and the laying of new cables; also for the repair and diversion of the existing cable. The form of tender is as follows:—The undersigned hereof undertakes to maintain, repair and work for 25 years submarine telegraphic cables belonging to the Government and laid between Cadiz—Teneriffe, Teneriffe and Grand Canary and Palma, and between Grand Canary—Lanzarote; (2) To lay a new cable between the two first-named places without any subsidy from the Government; (3) To lay three other new cables to be transferred to the Government in perfect working order, viz, one between Barcelona —Majorca; one between Tangier—Ceuta, and one between Chafarinas—Nemours (Algiers); and (4) To repair the existing cable between Tangier—Tarifa, and to conform to all conditions of the tender published in the *Madrid Gazette* of . . . . . , the price for the last three cables, and the repair of that between Tarifa—Tangier to be . . . . . pesetas for each nautical mile of 1,855·28 metres, payable in 25 years. The price to include cost of stations, repair ship, landlines (sites for cable houses to be granted by the Government), laying of subterranean cables between the landing and the telegraph office, if necessary, and all instruments. As guarantee of my offers I present the attached certificate of the deposit with the Treasury, as guarantee, the sum of 100,000 pesetas for permission to tender.

The conditions also state who is to pay agreement, &c, expenses, and that the Government are to superintend all the work (by one or more men to be appointed by them) in connection with the manufacture, passing of material, taking tests, and generally to see that all is carried out in the manner desired, the concessionaire to take all risks. Each inspector is to be paid a sum not exceeding 100 pesetas per day from the day of granting the contract to the final handing over of the cable, and the Government will deduct from the first payment to be made by them any sum due on this account.

Free passages and catering are to be accorded to these inspectors on the cable ship or ships.

The concessionaires to consult the Government delegates on all points not covered by the contracts, and to work the Canary Islands cables already existing, and that to be laid at his expense, under the immediate surveillance of the technical employés of the Government telegraph service.

The conditions then specify the instruments to be supplied, and deal with technical matters as to types, &c., of the cable; and in No. 12 it is provided that the concessionaire shall be responsible for all repairs to the cables necessary within a period of six months from being opened for service, and his responsibility will not cease until they have worked without any interruption for a period of six consecutive months.

The financial conditions in connection with the Canary cables provide that after the expiration of the 25 years before mentioned, all cables already laid, and those to be laid, with all instruments, are to be in perfect working order, and become the property of the Government without any indemnity to the concessionaire. The Government may, however, if it think fit, renew the concession, in which case, conditions being equal, the last concessionaire shall have the preference. During the period of 25 years, the Government will not lay, or permit to be laid, any other cable between Spain and the Canaries.

Official telegrams are to have priority and to be sent free, and the Government reserves to itself the right of control, in accordance with the conditions of the International Telegraph Convention.

Half the employés having the necessary ability are to be appointed from the Government telegraph service.

When the Government considers it necessary to take possession of the cables for defensive reasons, the concessionaire will not receive any compensation or indemnity whatever, but the period for which it takes possession will not be taken into account so far as the period of the concession is concerned.

If by any fault of the concessionaire an interruption of the cable between Spain and the Canary Islands, or those between the islands of this group are interrupted for more than one day, and the cables are in good electrical condition, the Government may take possession of the interrupted cable or cables, and apply the revenue as an indemnity for the expenses incurred until the concessionaire re-establishes communication.

Repairs to the cable between Cadiz and Teneriffe must be completed within six months. In case of *causes majeures*, the Government will, if they think circumstances warrant this plea, extend the time to one year. If not repaired within the extended period, every half year during which the interruption to the cable or cables lasts, will count as one year off the time of the concession. Should the interruption last for two years, the concession lapses, and the Government will take possession of the cables, offices, and all material.

The new cable to be laid within one year, or should *force majeure* intervene, any extended period. Financial conditions in connection with the cables from Barcelona to Majorca, Chafarinas to Nemours, and Tangier to Ceuta, as well as the divertion and repair of the Tangier-Tarifa cable, provide that the Government will pay for this work, and the total sum after it has been agreed, on the completion of the work and the working of the Canary cables existing and to be laid, will be paid by means of a yearly subsidy, payable quarterly for 25 years, calculated on the basis of 4 per cent. of the total cost incurred for the above work taken at 7,000 pesetas per nautical mile (1855·28 metres), together with interest at 5 per cent. on any balance remaining after each yearly settlement of accounts. The payment of the subsidy will only be made on production of a certificate from the surveillance committee that the cable is in the desired condition and has worked regularly.

The most advantageous offer will be accepted, and in this sense the terms of the contract, so far as the price of the cable is concerned, may be modified.

The above cables to be laid and repaired within eight months of the signature of the concession or any extended time the Government may see fit to grant on the plea of *force majeure*.

The last five years' subsidy and interest will be retained by the Government as a guarantee for the proper transference of the cables to them, and the sum will be forfeited if the cables, instruments, &c., are not delivered up in accord with the terms of the contract.

When the Canary cables have been handed over to the Government, in accordance with conditions, the sum retained will be paid to the concessionaire, and the same interest will be allowed as is given on the other guarantee money deposited.

When the cables have been laid and work well, and continue so during the period guaranteed, the guarantee money will be returned to the concessionaire.—*Journal Télégraphique.*

USE OF ELECTRICITY IN FACTORIES, &c.

The following are the Home Office draft regulations for the use of electricity in factories and other places, under the Factory and Workshop Act, 1901, briefly outlined in our last issue:—

Whereas the generation, transformation, and use of electricity in electrical stations, and in any factory, workshop, dock, wharf, quay, warehouse, or other place to which Sec. 79 of the Factory and Workshop Act, 1901, is applied by that Act, has been certified in pursuance of the said Sec. 79 to be dangerous:—

I hereby, in pursuance of the powers conferred upon me by that Act, make the following regulations, and direct that they shall apply to all places named above, other than electrical stations, in respect of the distribution and use of electricity where the normal working pressure is greater than 250 volts and less than 650 volts between any two conductors.

1. All wires in connection with the supply shall, where practicable, be completely enclosed in strong metal casing, and where this is not practicable they shall be so arranged that there shall be no danger of any shock or of fire.

2. All main and branch circuits shall be protected by switches and by fuses or other automatic cut-outs.

3. The supply to every motor or arc lamp shall be controlled by means of an efficient switch, so placed as to be easily handled by the person in charge of the motor or arc lighting, and connected so that by its means all pressure can be cut off from the motor or arc lamp and from any regulating switch resistance or other device in connection therewith: provided, however, that where the arc lamps are connected in series across the outer conductors of a three-wire system and the pressure cannot exceed 250 volts from earth, it shall be sufficient if one such switch be provided for each series of arc lamps.

4. All switches and cut-outs shall be so enclosed and protected or be in such positions or of such construction that there shall be no danger of any shock being obtained in the ordinary handling thereof, or of any fire being caused by their normal or abnormal action.

5. All metal holders for incandescent lamps, the frames of all motors, and the metal casings of all wires, switches, fuses and cut-outs, shall be efficiently connected with earth.

6. Where the electricity is derived from a public supply, the following conditions shall be observed:—

(*a*) A suitable safety fuse or other automatic cut-out shall be inserted in each service line, as close as possible to the point of entry into the premises, and contained within a suitable locked or sealed receptacle of fire-proof construction, except in cases where the service line is protected by fuses in a street box, but no fuse or cut-out shall be inserted in the intermediate conductor of a three-wire system.

(*b*) All service lines and apparatus shall be highly insulated and thoroughly protected against injury to the insulation and against access of moisture, and any metal forming part of the electric circuit shall not, unless efficiently connected with earth, be exposed so that it can be touched. All electric conductors shall be so fixed and protected as to be free from risk of electrical discharge to any adjacent metallic substance.

Provided that in regard to service lines and apparatus under the sole control of a person other than the occupier of the premises to which the supply is given, it shall be a sufficient compliance with Regulation 6 on the part of such occupier, if he obtains from such person in the month of January in each year a certificate that the Regulation is fully observed in regard to the said service lines and apparatus. Such certificate shall be produced at any time when required by H.M. Inspectors of Factories.

These Regulations shall come into force on the 1st day of January, 1905.

Any objections which may be put forward by employers or other persons affected, will be carefully considered by the Secretary of State; such objections must be lodged within 40 days of the 15th inst.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,684. "Improvements in alternating current electric motors." Union Elektricitats Gesellschaft. (Date applied for under Patents Act, 1901, October 9th, 1903, being date of application in Germany.) October 10th. (Complete.)

21,694. "Improvements in or in connection with electric motor controllers." H. V. James. October 10th.

21,722. "Improvements in rail joints and electrical bonds connected therewith." R. H. Radford. October 10th.

21,726. "An improved system of suspending conductor wires for the distribution of electrical energy." A. E. Cooper. October 10th.

21,729. "Improved swivelling coupling for electric cables." E. B. Phillips and T. C. Parkin. October 10th.

21,780. "Improvements in automatic thermal and magnetic circuit-breakers." R. Starke. October 10th.

21,784. "Improvements in the method of and apparatus for automatically opening or breaking at predetermined times an electric circuit or circuits." P. F. Corehill. October 10th.

21,795. "An improved dynamo-electric clutch." R. von Lieben and E. Reisz. October 10th. (Complete.)

21,796. "Improvements in and relating to controllers for electric motors." A. Churchward. (Date applied for under Patents Act, 1901, October 10th, 1903, being date of application in United States.) October 10th. (Complete.)

21,819. "Improvements in automatically-operated telephonic exchanges for a small number of lines." A. M. Fullard. October 11th. (Complete.)

21,846. "Improvements in electric switches." T. A. Cameron. October 11th. (Complete.)

21,848. "Telegraph recorder." W. J. Roussel and A. King. October 11th. (Complete.)

21,889. "Electric alternating current machines." K. A. Lindstrom. (Date applied for under Patents Act, 1901, October 16th, 1903, being date of application in Sweden.) October 11th. (Complete.)

21,892. "Improvements in electric arc lamps." F. M. Lewis. October 11th.

21,894. "Improvements in regenerative dry batteries." W. H. Gregory. October 11th. (Complete.)

21,895. "Improvements in electric telegraphs." Siemens Bros. & Co., Ltd., and G. S. Grimston. October 11th.

21,902. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd., and R. C. Clinker. October 11th.

21,908. "Improvements in electricity meters." The British Thomson-Houston Co., Ltd., and W. J. Lloyd. October 11th.

21,911. "Improvements relating to electric batteries, electrolytic apparatus, or the like. P. Marino. October 11th.

21,913. "Improvements in the manufacture of galvanic cells." R. Zielenberg. October 11th. (Complete.)

21,966. "Improvements in electric heat alarms." R. W. Bill and S. Bill. October 12th.

21,995. "Improvements in and relating to intercommunication telephone systems." I. B. Birnbaum and H. G. White. October 12th.

22,000. "Improvements in electric motors." P. Jigouzo. (Date applied for under Patents Act, 1901, October 21st, 1903, being date of application in France.) October 12th. (Complete.)

22,003. "Improvements in conduits for electric cables or conductors." T. E. Devonshire. October 12th.

22,085. "A wireless telegraphy receiver capable of recording or printing only waves of a given strength." F. P. Reid. October 14th.

22,100. "Improvements in or relating to certain parts of electrical circuit-breakers and automatic switches." The Electric and Ordnance Accessories Co., Ltd., and R. F. Hall. October 14th.

22,107. "A device for picqueting horses, mules, cattle, and for guide-ropes for tents, telegraph poles and the like." J. H. Connor. October 14th.

22,118. "Improvements in apparatus for automatically operating the points of electric tramways." W. R. Evans. October 14th.

22,156. "Improvements in commutators for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 14th.

22,157. "Improvements in dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 14th.

22,164. "Improvements in or relating to apparatus for use in the distribution of alternating electric current." A. F. Berry. October 14th.

22,171. "Improvements in connection with electric switchboards to protect persons from injury." The Elektrizitats Act.-Ges. vormals W. Lahmeyer and Co. October 14th. (Date applied for under Patents Act, 1901, December 31st, 1903, being date of application in Germany.) (Complete.)

22,178. "Improvements relating to electric heating." F. E. Spon. October 14th.

22,206. "Electro-magnetic press." Sir B. Scott, E. H. Quarrington and T. H. Hodgkinson. October 15th.

22,210. "An improvement in or in connection with dry voltaic cells and primary batteries." C. M. Stead. October 15th.

22,218. "An improved electric wire terminal clip." G. R. Cartmel. October 15th.

22,236. "Improvements in electric lamp fittings." A. J. Ponsella. October 15th.

22,246. "Improvements in and relating to the distribution of electricity for electric traction." C. Gibbs. October 15th.

22,247. "Improvements relating to electric lamps." A. K. Baylor. October 15th.

22,258. "An improved means for the application of electricity to the human body." C. Rigola. October 15th. (Complete.)

PATENTS EXPIRING DURING 1904.

We are informed by W. P. Thompson & Co. that about 784 complete applications for electrical patents were filed in the year 1890. Only 38 of the patents granted on these applications have been maintained for their full term, viz., 14 years, and being of considerable value, we give short abstracts of them below:—

911. "Apparatus for winding ribbons or tapes of insulating material around electrical conductors." S. Pitt. (J. B. Atherton, U.S.A.) January 17th, 1890. Relates to machinery for covering electric conductors with spirals of ribbons or tapes. The machine is adapted for winding two spirals of ribbon in opposite directions. The machine may also be used singly, the various spirals being put on by different machines, although driven from the same shaft. The ribbons are placed in the form of spools or coils on rotating tables, and pass between tension fingers and guides before being wound upon the wires. Additional spools of ribbon or tape are threaded on the wire before starting, and are supported by brackets. A compressing and smoothing die is supported over and carried by each table. After the wire is covered, it passes over grooved stretching drums and thence to a take-up reel. Knock-out motions are described by which, on the breakage of a ribbon or emptying of a spool, the machine is automatically brought to rest.

1,143. "Improvements in or connected with telegraphic apparatus applicable for use in navigable vessels and analogous purposes." W. Chadburn. January 22nd, 1890. Relates to means for ensuring that the pointer or dial of a receiving instrument shall always point to the centre of the desired indication or order, &c., and also to means for sounding the reply or tell-tale bell at the commencement and at the end of the movement. A star-wheel carrying the pointer or dial and having as many notches as there are orders to be transmitted, is fitted to rotate between stops on a shaft rotated from the transmitting instrument. A roller carried by a spring bears on the wheel and causes the pointer, &c., to move to the centre of an indication, even when the shaft has not been sufficiently rotated. For the reply or tell-tale gear two star-wheels with the teeth of one opposite the notches of the other are arranged alternately to engage central projections on two levers which operate two sets of two rods surrounded by springs and carrying the bell hammers which strike the bell. The shaft is fitted with a star-wheel. The invention is not limited to the device above described, but comprises any means whereby the pointer, &c., is partly moved positively from the transmitter or receiver and partly by a spring or its equivalent. The invention is stated to be applicable to "engine room," "steering," "docking," "look-out," "turret," "gun," and other telegraphs for ships and for other purposes.

1,866. "Improvement in galvanic dry batteries." C. Smith. January 24th, 1890. An outer casing contains a zinc receptacle and a cylindrical carbon block. The space between the casing and the zinc receptacle is filled with sawdust or like material. The carbon tube is filled with an absorbent material such as slag wood impregnated with saline solution, and its exterior is covered with a depolarising substance contained in a bag. A plastic substance placed between the zinc receptacle and the depolariser contains the electrolyte. Above the slag wood is placed a paste of plaster of paris, tragacanth and saline solution, and above the plastic substance is placed plaster of paris, the whole being covered with a layer of pitch or the like. The gases escaping from the electrolyte pass through the plaster of paris and impregnate into the space between the casing and zinc receptacles, whence they escape through pipes.

2,219. "Improvements in telegraph printing apparatus." H. O. Rudolph. February 11th, 1890. Relates to apparatus for printing on a tape or ribbon. The transmitter is constructed with a series of keys connected to pivoted levers provided with links which, by their action, throw pins into the path of rotating arms. The rotation of the arms is produced by escapement driving-wheels actuated by anchors on a pivoted armature lever, which also carries contact-apparatus for making and breaking the local magnet circuit and for sending alternating impulses to line. The transmitter may have a type-wheel for producing a copy of the message. The receiver is driven by a spring controlled by an escapement on a pivoted armature lever. A "Geneva detent" is employed for ensuring the return of the type-wheel to its normal position. The type-wheel and spacing and printing magnet are similarly arranged to the transmitter, and are actuated by the alternating impulses sent to line from the transmitter, a prolonged impulse bringing the type-wheel to rest, and causing the printing-lever to record the required letter.

2,658. "Improvements in electric meters." S. Z. de Ferranti. February 18th, 1890. Consists in suspending, or partially suspending, the armature spindles by magnets which may also serve to produce Foucault currents in a metallic disk carried by the spindle. An arrangement is shown applied to the meter described in Specification No. 1,480, A.D. 1889. The armature spindle carries an iron disk, acted upon by a ring magnetised by coils, which lifts the disk until it is nearly in a central position, or until the upper end of the spindle comes against the upper end of the bearing. The form of the magnet may be modified: a copper disk in which Foucault currents are produced, may be attached to the spindle or disk, and the invention may be applied to horizontal spindles.

2,945. "Improvement in and relating to and in the manufacture of electric secondary cells." A. M. F. Laurent Cely and I. S. Timmis. February 21st, 1890. Lead chloride is fused in a closed furnace to exclude the air as much as possible and metallic zinc is added to the fused chloride. The molten mixture is run into hinged moulds wherein it is formed into small rectangular grooved plates of various shapes, which are washed successively with concentrated hydrochloric acid and water. Those plates which are to be converted into positive electrodes are converted into litharge by first electrolytically reducing them to cellular lead and then oxidising. A number of plates are then symmetrically arranged in a mould by means of a templet and a frame or support of antimonious lead is cast around them. In making the negative electrodes the chloride of lead plates have a frame or support of antimonious lead cast about a number of them as above, and they are then reduced to cellular lead by electrolytic action.

3,082. "Improvements in filaments for incandescent electric lamps." R. Langhans. February 26th, 1890. Relates to the protection of filaments from oxidation. The carbon or metallic filaments are covered with an electrically-conducting coating of silicon or boron, by placing the filaments in a vessel exhausted of air, or filled with a chemically-indifferent gas, in contact with a compound of silicon or boron, capable of being decomposed with deposition of silicon or boron in a crystalline or graphitoidal form, by the action of heat, or of an electric current, with or without the aid of a chemical decompositing medium. The compounds mentioned as suitable are—silicon-tetra-methyl, and tetra-ethyl, silicon-propyl, silicon-phenyl, sulphocyanide of silicon, siliciuretted nitrogen, silicon pyridine, and analogous boron compounds.

3,096. "Improvements in electric meters." S. Z. de Ferranti. February 26th, 1890. Relates to meters of the kind described in Specifications No. 5,926, A.D. 1888, and No. 701, A.D. 1887, in which the current to be measured passes through a mass of mercury so arranged in a magnetic field that the mercury is set in motion and the movement recorded by a suitable counter when the current passes. A shunt coil and a series coil are enclosed between two sets of annular troughs formed of sheets of iron or tin plate, some of the outer plates being cut away on their outer side, so that the amount of iron is the same on the interior as on the exterior of the coils. A portion of the shunt coil, which assists in the starting of the meter, is wound with non-inductive winding. The mercury bath is formed of two insulating-disks, which are pressed against a ring by the annular troughs, the whole being secured together between plates by means of bolts. Disks immersed in the mercury are connected with counting-mechanism by a spindle. Levelling-screws may be used; the screw after adjustment may be locked by a pin, &c., and then held down, and the meter secured to its table or shelf by a wood screw. Meters of the kind described above, or of the "Frager" or "Aron" type, &c., are provided with an enclosing case or cases to cover the ends of the securing-fastenings and the sockets in which the leads are fixed, the cover being secured with a sealed or locked fastening. The casing may also serve to prevent any tampering with the meter after standardizing.

4,301. "Improvements in sound receiving apparatus." F. D. Torre. March 19th, 1890. Relates to a topophone or apparatus for determining the direction or position of an object from which sounds emanate, or are reflected, especially applicable for marine signalling.

5,474. "Improvements in regulating and controlling the resistance of electric circuits." H. Lyon and H. J. Leslie. April 10th, 1890. A jar is fitted at the bottom with a fixed conical metallic plate; a second plate is carried by a screwed spindle fitted with a hand-wheel. The jar contains acidulated water or other liquid, and the resistance is adjusted by turning the wheel, and so raising or lowering the plate.

7,932. "Improvements in mandrels for electrolytically deposited tubes." F. E. Elmore. May 22nd, 1890. Mandrels for the electro-deposition of metal tubes are formed by coating a metal tube with fusible metal, or with paraffin, which may be mixed with salt to render it porous when the salt is dissolved, or the paraffin may be perforated, or the mandrel may be perforated and coated with gelatine. The external layer is rendered even by means of a heated roller placed parallel to the axis of the mandrel. The tube is burnished in the bath while depositing by means of a roller.